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Aging of Elastic Tissue in Human Skin

C. K. MA and E. V. COWDRY

USING BIOPSY SPECIMENS FROM THE ANTECUBIAL REGION OF 11 YOUNG ADULT AND 8 SENILE MALES DR. MA AND DR. COWDRY OBSERVED A MARKED DECREASE IN THE AMOUNT OF ELASTIC TISSUE WITH AGE. THE DECREASE WAS MORE NOTICEABLE IN THE SUBEPIDERMAL PLEXUS THAN IN THE DEEP FIBER LAYER.

SKIN is a very favorable structure in which to study the processes of aging, because it can so easily be seen and examined. It has been said that "when the skin of the back of the relaxed hand of a medical student is pulled up between finger and thumb and released it snaps back into place; whereas that of the senile instructor subsides slowly and with dignity because elasticity is reduced."

Dermal shrinkage has been investigated by Evans, Cowdry, and Nielson (8) in the antecubital region by the measurement of marked areas before and after excision from volunteers. It was demonstrated that dermal shrinkage is decidedly more vigorous in young persons than in old ones.

Difference of opinion exists as to which component of the dermis chiefly conditions elasticity. According to Lynch (14) collagenic tissue is the major factor. However, Sternberg (20) has stated that extensibility is due to the arrangement of connective tissue fibers and that overdistension is prevented by the system of elastic fibers.

Several other observations on human dermal elastic tissue are to be found in the literature. Schmidt (19) reported in 1891 that the elastic fibers swell, become homogeneous in structure, tend to flow or merge together, and finally break down in old age.

Facial skin was examined by Reizenstein in 1894 (17). Age of most of his samples ranged from 18 to 55 years. He seems to have confirmed Schmidt's observations except that alterations were observed by him as early as 26 to 28 years of age; whereas, according to Schmidt, they appeared at 40. It is important to note that Reizenstein's specimens showed no signs of inflammation.

In 1910, White (23) published the results of an extensive investigation of dermal elastic tissue in both diseased and normal senile subjects. He called attention to the importance of environmental influences and described several disturbances in elastic elements in unprotected areas after long and frequent exposure to sun and wind as well as in disease.

Vohwinkel (22) investigated elastic tissue in the skin of the face in 1931. The age of samples ranged from 5 to 101 years. In his opinion senile alterations commence in the fourth decade, starting in the stratum suprius and extending down to the stratum inferius with advancing age. The alterations involved degeneration of both elastic and collagenic fibers and resembled those caused by roentgen rays and radium.

In the same year appeared the results of a roughly quantitative study by Lindholm (13), who concentrated his attention on specimens taken from the abdomen, thorax, and thigh of subjects from 1 day to 80 years, including 17 females and 15 males. He concluded that elastic fibers are more numerous in children than in adults, and in females than in males.

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In exposed parts of the body, Ejiri (5, 6, 7) found degeneration and fragmentation of elastic fibers with advancing age. Degeneration of elastic fibers, localized in the middle layer of the cutis, commenced in the fourth decade and became distinct before the fifth decade. Changes of elastic fibers situated more deeply began for the most part at the end of the sixth decade and became distinct in subjects over 60. The intensity of the changes increased with age and they were less marked in women than in men.

In 1940, Hill and Montgomery (10) contributed observations on skin samples taken from the web between the toes, the pubis, axilla, chest, and scalp from 20 different individuals whose age was from 7 months to 78 years. They concluded that the network of elastic fibers in covered parts of the body does not exhibit the senile degenerative alterations described by Ejiri, which they attributed to the effect of light and the elements on exposed regions.

A more recent publication is that of Dick (3). He studied 32 different individuals, 17 males and 15 females in the age range from 0 days to over 60 years. Samples were obtained from the feet, limbs, abdomen, and chest. He observed definite senile changes both in the subepidermal elastic plexus and in the deep elastic fiber layer. In subjects over 65 years of age, the deep elastic fibers showed rough thickenings in the fibers, irregular fragmentation of their ends, and variability in length. Also, in contrast to the even distribution of elastic fibers of younger subjects, he noted condensation and aggregation of the fibers into irregular masses.

From this brief review it is evident that several factors, including the health and sex of subjects as well as the region whence the samples are taken, must be considered in the investigation both of the onset of senile alterations of dermal elastic fibers and of their progression. The results herein reported are strictly limited to observations on one sex, a single area, and normal material.

Material and Methods

It was believed that a relatively complete body of data concerning a single area would be more useful than the more diffuse information to be obtained from a regional survey and that this area should be so located that observations would be unaffected, as far as possible, by environmental influences. The antecubital region seemed best to meet these requirements for the following reasons: it is protected by its position from many radiant and mechanical traumata even when uncovered; clothing usually is loose over this region and rubbing is at a minimum; sufficient "slack" is provided partially to compensate for the pulling and stretching of movements; the relative efficiency of evaporation and the absence of apocrine glands minimize a possible physicochemical interference.

All specimens were obtained by biopsy from patients in two institutions for indigent or mentally deficient cases, and in each instance clinical records were studied in order to eliminate subjects whose physical condition might have introduced a confusing factor. Because of the known tendency to greater individual variation in females, only male subjects were used. These are listed below in 3 groups by the age in years. More than one at any age are indicated by the number in brackets.

1. Young Adults: 19, 20(3), 24(4), 25, 30, 32
2. Seniles: 78, 80, 85, 86(2), 87, 91, 94
3. Intermediates: 54, 58, 66, 73

In addition, and to elucidate the embryonic condition of dermal elastic tissue, samples from a 4 month female fetus were examined.

The technique of biopsy was standardized as follows: the field was washed gently with bland soap and water and was rinsed with 70 per cent alcohol. Blebs were raised in the skin by intracutaneous injection of a solution of 2 per cent novocaine in physiologic saline so as to produce a continuous ridge surrounding an oval area of several square centimeters, varying in extent according to the amount of tissue required. None of the anaesthetic was injected subcutaneously and the tissue was immediately removed by an elliptical incision within the anaesthetized area, so placed that its edge was at least 0.5 cm. from the novocaine blebs. This precaution seemed advisable in order to minimize possible volume changes and chemical changes resulting from altered osmotic conditions. After division into the required number of pieces, the tissue was straightened gently on paper and immeditely placed in the fixative or otherwise stored for physico-chemical studies.

Precautions were taken to ensure uniformity of shrinkage. All specimens were fixed in Bouin's fluid for twenty-four hours and the methods of staining were standardized. Harris' modification of Delafield's hematoxylin, with eosin as counterstain, was used routinely on all tissue. In addition special fixative and special staining methods were employed in a number of other studies.

Thus all the previously mentioned materials, except the fetal skin, were collected and prepared as has been described by Evans, Cowdry, and Nielson (8). The use of these materials in this study constitute a logical extension of their work. A third paper in this series of contributions on aging of the human skin is that of Cowdry, Cooper, and Smith (1), which deals with regional alterations in the epidermis.

In the present investigation tissues fixed in Zenker-formol by the previously mentioned workers were employed. Sections were cut 25 μ thick and were stained with alcoholic orcein. For purposes of comparison stored slides of material fixed in Bouin's fluid, cut 10 μ thick and stained with Weigert's resorcin fuchsin, were consulted. Slides stained with hematoxylin and eosin were also routinely examined.

Since the specimens of Evans, Cowdry, and Nielson were not prepared primarily for elastic fiber study, in embedding they were not orientated in a definite relation to the direction of elastic fibers. Therefore, in a given section, longitudinal, cross, and oblique sections of elastic fibers were occasionally encountered. This was borne in mind in interpreting the microscopic findings.

Another point worthy of mention is the difference between the thick sections stained with orcein prepared specifically for this study and the thinner ones stained by Weigert's method. Elastic fibers in a thick section seem to be more numerous. The obvious advantage of thick sections is that, when examined under a binocular microscope, alterations in depth are more easily detected.

Observations

In most textbooks of histology the dermis is described as composed of two layers: papillary and reticular. The latter has been divided by Schiefferdecker (18) into three strata: superius, medium, and inferius. The same usage was observed by Vohwinkel (22).

Upper cutis, mid-cutis, and subcutis have also been used as synonyms (10).

In the dermis of the 4 months fetus no elastic fibers were present except those in the walls of blood vessels. This observation is a little at variance with the reports of Lynch (14), but the difference may be due to error in the calculation of age. However, it is not our primary intention to determine the exact time of elastic fiber appearance or to explore their intra- or extra-cellular development.

From 5 years on, dermal elastic tissue is considered in this report to be divisable into two strata: a subepidermal plexus of fine elastic fibers and a deep layer of much larger fibers (3). The former is confined to the papillary layer, the latter is distributed throughout the reticular layer and seems to be more important in connection with the gross physical property of the elasticity of skin.

In order to present the data best, the 24 subjects have been classified into 3 groups. Elastic tissue in the first group of young adults is represented in figures 1, 2, and 3; while that of the second group of seniles is represented in figures 4, 5, and 6. Examination of the third and intermediate group has not been helpful in the discovery of transitional changes between the first two.

Subepidermal plexus.—This plexus is immediately proximal in position to the epidermis and consists of fine fibers which interlace with one another to form a dense network spreading out beneath the epidermis. From this network fine fibers extend in a distal direction into dermal ridges or papillae.

In the skin of young adults (group 1, age 19 to 32), this plexus is well formed and composed of strong, vigorous looking fibers (figs. 1, 2, 3). In the skin of senile subjects (group 2, age 78 to 94), the fibers of this plexus are thinner (some are split up into fine fibrils), diminished in amount, and in some instances even a continuous layer may be lacking. The contrast is even more striking than the comparison of figures indicates, but in both groups there is some individual variability. In view of the greater shrinkage of the young skin than of the old skin, already alluded to, one must expect rather more accentuation of the fibers through reduction of the extent of the area over which they are spread *in vivo* in the former than in the latter. However, this factor would not be nearly sufficient to account for the reduction in elastic tissue illustrated in the figures.

Deep elastic fiber layer.—Throughout the reticular layer, elastic fibers are distributed among collagenic ones. Some of these elastic fibers are much thicker than those present in the subepidermal plexus. They form loosely woven elastic sheets through which project the internal epidermal appendages, glands, and hair follicles in addition of course to blood vessels, nerves, and lymphatics.

In young adults, the elastic fibers of this layer are thick, robust-looking, well stained, evenly distributed, and are apparently in a stretched condition (figs. 1, 2, 3). In the skins of senile subjects, on the contrary, the elastic fibers are thinner, frailer, sometimes split into fibrils, quite wavy, and diminished in amount. Moreover their even distribution is disturbed, since they tend to be accumulated in some areas and to be absent in others (figs. 4, 5, 6). This may be partly occasioned by reduction in number of internally projecting epidermal appendages.

The vitreous, or hyaline, degeneration observed by Ejiri was not found in our specimens; even transverse fragmentation was rare. Elastic fibers in the senile skins stain fairly well with alcoholic orcein and show the usual tinctorial properties in hematoxylin and eosin preparations. In sections colored with Weigert's resorcin fuchsin, some collagenic fibers also are intensely stained but they are usually distinguishable from the elastic fibers by their size, shape, and location.

Evidently decrease in the amount of elastic tissue in the senile skins is more marked in the superficial than in the deep parts of the dermis. But this microscopic study of elastic tissue

yields only very rough quantitative data. Even within the confines of the antecubital area regional variations occur.

Ground substance.—This extremely important dermal component seems to change with age. Detailed comparison of sections of young and old skins, fixed in the same fluid, cut the same thickness of 25 μ, and stained with orcein in the same manner, reveals a cloudiness and lack of clarity in the ground substance about the elastic fibers in the latter not found in the former. This difference was not observed in the 10 μ sections stained with resorcin fuchsin. Neither was it detected in 10 μ sections colored with hematoxylin and eosin.

Discussion

The series of specimens examined was not very complete. Many ages were not represented and the likelihood of individual differences so common in all studies of the processes of aging must not be ignored. In contrasting the dermal elastic tissue in the two groups of young adults and senile individuals the alterations observed in the latter, extending with several gaps from 78 to 94 years of age, were noteworthy. The observations, in general, confirm Hill and Montgomery (10) as to the approximate time of the appearance of senile modifications.

The intermediate group was too small and too scattered as to age to justify any conclusions. However, some indications of the irregularity in diameter of the fibers and in their length reported by Dick (3) were seen, but these could have been illusory, dependent on the variation in plane of section and other factors. It is likely that restriction of specimens to a single protected area not subject to vagaries of exposure to sun, wind, and other factors likely to operate differently on different individuals gave a more faithful picture of alterations occasioned mainly by the normal processes of aging. Probably limitation to a single sex was also helpful.

The observations made confirm the previous discovery by others that decrease in elastic fibers first occurs in the outer part of the dermis and then spreads to the deeper strata. This decrease, determined very crudely by microscopic examination, should have been checked by quantitative chemical determinations of elastin employing Lowry's technique which has been of assistance in the investigation of experimental epidermal carcinogenesis (Ma, 15); however, the material was not available in a suitable condition for analysis. The decrease of elastic tissue should also have been checked by measurements of elasticity of the skin in living subjects employing the methods devised by Kirk and Kvorning (11). These investigators selected the skin over the anterior medial surface of the tibia for investigation and divided their subjects into two groups: 18 to 25 years and 60 to 90 years, which correspond closely to the young adults and senile individuals with whom this report on microscopic observations deals. Sizeable differences, expressed quantitatively, were discovered by Kirk and Kvorning.

With advance in age elastin may change, as has been reported, into elacin identified by Unna (21) by its basophilia when polychrome stain is applied; but of this no evidence is offered in this paper. The demonstration by Lansing and Alex (12) that with aging of arterial elastin there is an increase in its content of dicarboxylic amino acids as well as in its calcium content suggests the possibility that some chemical change in elastin may also take place in other parts of the body including the dermis.

Gross (9) has found by electron microscopic examination and by experimentation that elastic fibers from many sources are made up of two components: trypsin resistant threads in a trypsin digestible, heat resistant, amorphous binding matrix. The microscopically visible fibrils, into which the fibers split up in aging dermis, are probably not these threads observed by Gross but bundles of them.

The modification herein reported in the ground substance or in the tissue fluid of the dermis of senile subjects may have been passed over unnoticed by previous investigators of

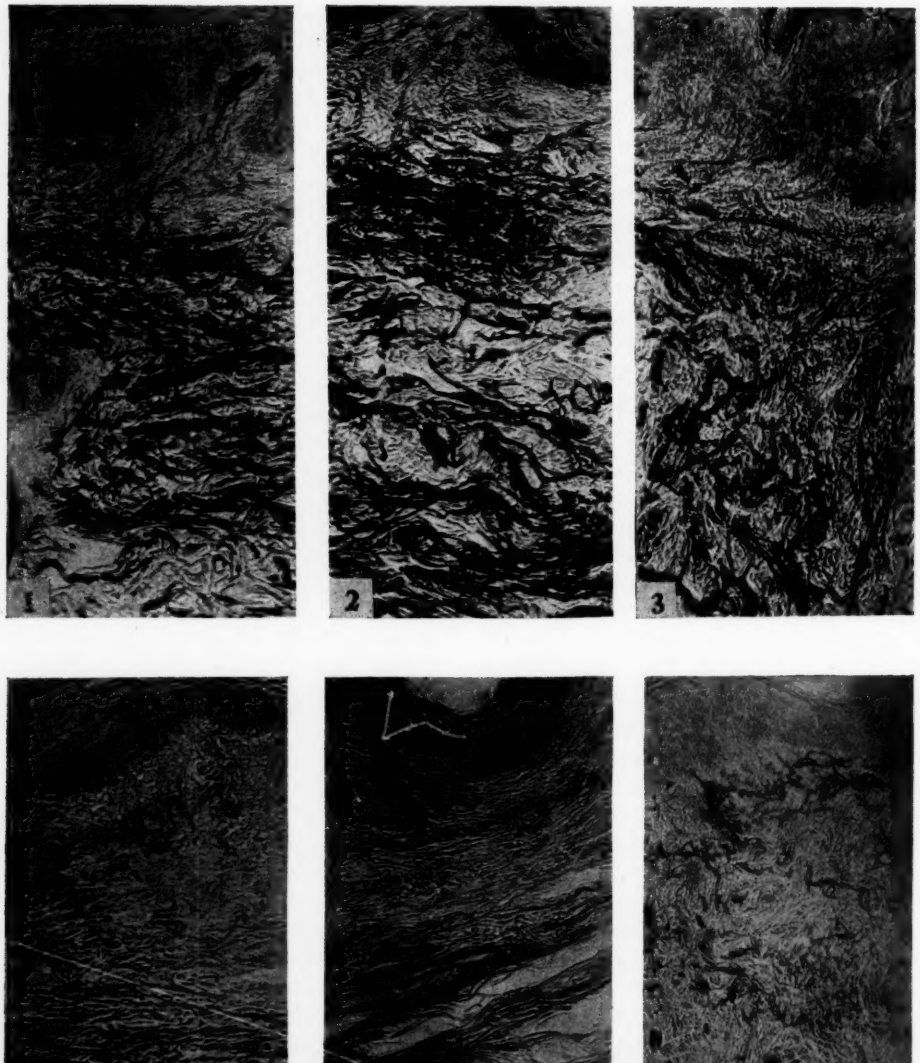

FIG. 1. All figures are photomicrographs taken at 350 diameters of biopsy specimens of antecubital skin fixed in Zenker formol. Sections were cut at 25 μ and stained with alcoholic orcein for elastic tissue. The upper row is of the young adult group age from left to right: 19, 24, and 32 years. The lower row is of the senile group age 86, 78, and 94 years.

human skin because in all probability most of them employed thinner sections in their search for microscopic details in which the cloudiness would have been less apparent. Moreover, it appears that earlier workers did not focus their attention so exclusively on absolutely fresh biopsy materials promptly and uniformly fixed. Perhaps it would have been missed in the examination of more or less stale specimens.

All that it is safe to say in the way of a provisional interpretation on the slender basis of the single rather crude tinctorial method employed is that this observation is consistent with the view that there is an increase, or a change, in the properties of a material, or materials, in the ground substance manifest in senile individuals. If this turns out to be the basophilic polysaccharide, hyaluronic acid, or a related substance, one would expect the permeability of senile dermis to be somewhat less than that of the dermis of young adults. Duran-Reynals (4), in a critical review of what is known of tissue permeability and spreading factors, reports that the skins of old animals are in fact less permeable than those of young ones (16). Actually it is the spread of substances, such as trypan blue, within the dermis and not in the epidermis that has been measured. If in humans, likewise, old dermis is less permeable than young dermis, the decrease in permeability with age may be in some way related to the cloudiness detected in the ground substance of the dermis of the senile subjects but not found in that of the young adults. It is possible, therefore, that the cloudiness, or lack of clarity, indicates the presence of material of a gel-like consistency such as hyaluronic acid in the senile dermal tissue fluid which offers resistance to the spread of substances, not exhibited by the corresponding tissue fluid of young adults, which by contrast is characterized by its optical clarity.

Summary

In contrasting the dermal elastic tissue of biopsy specimens of skin of a group of 11 young male adults of age range 19 to 32 with those of a group of 8 senile males of age range 78 to 94 marked differences were observed. These included in the latter a decrease in the amount of elastic tissue, which was more evident in the subepidermal elastic plexus than in the deep fiber layer. In the subepidermal plexus a splitting of elastic fibers into component fibrils was observed which is consistent with the idea that the material binding them together was loosened. In the tissue fluid between both superficial and deep fibers a cloudiness, or lack of optical clarity, was seen, which may be correlated with a decrease in permeability.

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Significance of Medial Age Changes in the Human Pulmonary Artery

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THE AUTHORS COMPARE THE PULMONARY ARTERY, WHICH USUALLY DOES NOT SHOW ARTERIOSCLEROTIC CHANGES, WITH THE AORTA, WHICH FREQUENTLY DOES. THEY CONCLUDE THAT THE LOW RATE OF CALCIFICATION OF MEDIAL ELASTIC TISSUE OF THE PULMONARY ARTERY IS AN IMPORTANT FACTOR IN LIMITING FORMATION OF ATHEROMATOUS LESIONS.

THIS laboratory has stressed the view that arteriosclerosis is a problem of aging (1, 2, 3, 4). Our observations indicate that calcification of medial elastic tissue predisposes both elastic and muscular arteries to form atheromata. This concept of arteriosclerosis, and for that matter, any other hypothesis, must account for the distribution of arterosclerotic lesions. Why do atheromata form in some vessels and not in others? Why, as in the aorta, do atheromata appear more frequently in the abdominal than in the thoracic portion?

The pulmonary artery is particularly important since it serves as a natural control for observations on the aorta; like the aorta it is an elastic artery having its origin close to the heart but differs sharply from the former in that it is uncommon to find atheromata in the pulmonary artery. If the calcification of medial elastic tissue as demonstrated in the aorta is requisite to intimal plaque formation, then the senile pulmonary artery should be relatively free of this elastic tissue age change. The present experiments were designed to explore the nature of differences between the pulmonary artery and aorta with respect to elastic tissue and calcific changes.

MATERIAL AND METHODS

A total of 106 human pulmonary arteries were utilized in these studies. The arteries were obtained at autopsy and stored in a deep-freeze for varying periods of time. Except for age, none of the material was selected on the basis of sex, color, or cause of death. By far the majority of subjects involved came to autopsy as a consequence of violent or sudden death.

In the preparation of elastin from these pulmonary arteries, the adventitia and, to a large extent, the intima were stripped from the media. The media was then fat extracted by refluxing in acetone or methyl alcohol-acetone mixtures. After this extraction the dried media was digested in 0.1 N NaOH at 98 C., for forty-five minutes. This procedure is our modification of Lowry's method for elastin preparation (5). The elastin so acquired was dried at 105 C. and weighed. The calcium content of the dried pulmonary elastin was determined by the method of Salomon, Gabrio, and Smith (6).

OBSERVATIONS

Elastin.—The data on changes of elastin with age in the human pulmonary artery are summarized in table 1 and figure 1. During the first three decades of life the media of the pulmonary artery contains slightly less than 31 per cent elastin. This increases slowly but steadily throughout life to 34 per cent in the seventh decade and to almost 37 per cent in the eighth decade. The increase of elastin with age although small is statistically significant. In figure 1 the elastin content of the pulmonary artery is compared to that of the aorta prepared in identical fashion. The details of the observations on the human aorta from which these data are abstracted have been previously reported (4).

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Two interesting conclusions are suggested by this comparison. First, it appears that while the pulmonary artery elastin content increases with age, that of the aorta shows a slight decrease between the second and third decades of life after which the elastin content is quite constant. In the first decade of life the media of the aorta contains 48.5 per cent elastin, in the second decade the elastin content is 48.2 per cent, while in the third decade the elastin content falls to 43.3 per cent. A second observation is that with advancing age the elastin contents of the pulmonary artery and the aorta tend to approach a common level.

Calcium in Elastin.—The data we have obtained on the calcium content of medial elastin from the pulmonary arteries ranging in age from 6 months to 79 years are summarized graphically in figure 2 and are tabulated in table 1. The calcium content of elastin during the first four decades of life is strikingly low (0.17, 0.15, and 0.18 per cent for the age periods 0-19, 20-29, and 30-39, respectively). There is a slow but steady increase in calcium content throughout the years to a maximum of 0.66 per cent in the eighth decade.

The low calcium content of elastin in the media of the pulmonary artery even at advanced ages is even more impressive when contrasted with similar data (4) obtained for the aorta (fig. 2). The calcium content of elastin of the aorta climbs rapidly after the third decade of life to as much as 6.8 per cent in the eighth decade.

Discussion

The salient observation in the present study is that calcification of medial elastic tissue in the human pulmonary artery progresses very slowly with advancing age. This situation contrasts very sharply with that found in the human aorta in which marked calcification of medial elastic tissue occurs in the third decade of life.

As indicated in the introductory paragraphs, the pulmonary artery is especially interesting in studies of arteriosclerosis in that this vessel does not usually contain atheromata. The fact that its elastic tissue does not actively undergo an apparently common age change (calcification) lends support to our view that calcification of medial elastic tissue predisposes arteries to form atheromata.

What is the situation as regards calcification of medial elastic tissue in those pulmonary arteries which do contain atheromata? In our study of 106 pulmonary arteries there were two such vessels. Both of these appear conspicuously in figure 2 as the highest calcium values in the pulmonary series. One 69 year old specimen contained 3.10 per cent calcium while a second 69 year old specimen contained 2.06 per cent calcium. It seems that in the

pulmonary artery, too, atheromata are associated with calcification of medial elastic tissue.

Summary

Data are presented which indicate that the calcium content of elastin of the pulmonary artery increases very slowly with age in contrast to the aorta, which calcifies very rapidly with age. It is suggested that the infrequent occurrence of pulmonary atheromata is dependent upon the low rate of calcification of the medial elastic elements.

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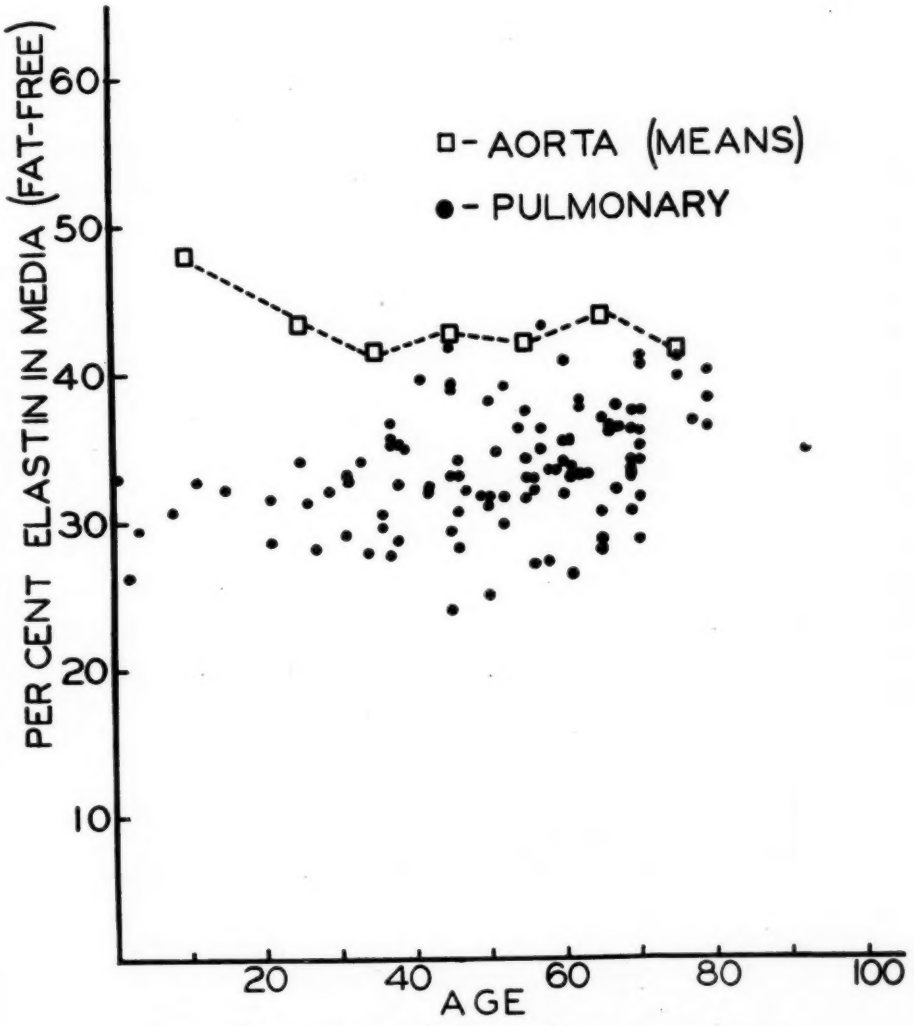

Fig. 1. Changes with age in elastic tissue of human pulmonary arteries. To be compared with values for the aorta.

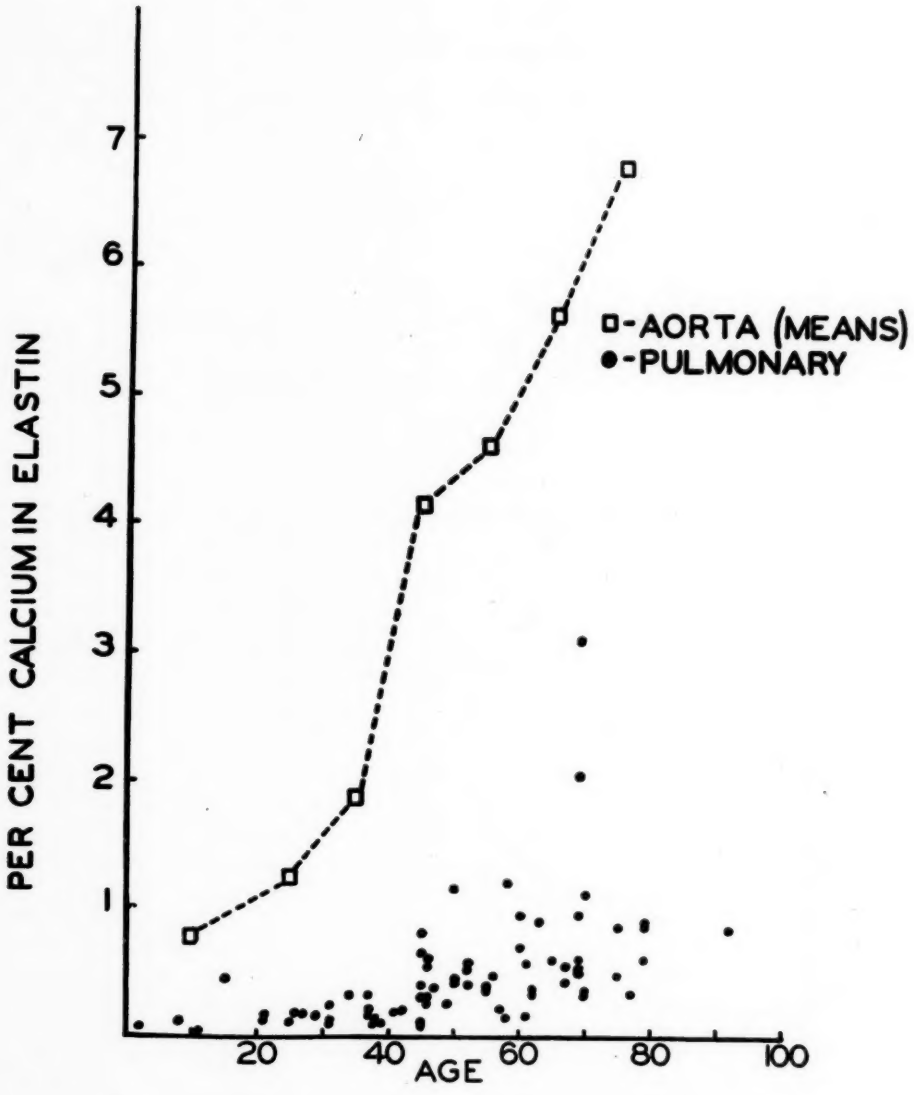

FIG. 2. Increase of calcium content of pulmonary arterial elastin with age. To be compared with values for the aorta.

TABLE 1. SUMMARY OF DATA ON ELASTIN AND CALCIUM CHANGES WITH AGE IN HUMAN PULMONARY ARTERIES

Age Group	No. of Analyses		Mean % Elastin in Media	Mean % Calcium in Elastin
	Elastin	Calcium		
0-19	6	4	30.6±1.05	0.17
20-29	6	6	30.9±0.98	0.15
30-39	15	10	32.1±0.84	0.18
40-49	15	14	33.3±1.27	0.37
50-59	22	12	33.2±0.90	0.57
60-69	27	14	34.0±0.65	0.62
70-79	15	10	36.6±1.01	0.66

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Age Changes in Pupil Size

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FROM AN INVESTIGATION OF MEASUREMENTS OF PUPIL SIZE MADE ON 222 SUBJECTS FROM 20 TO 89 YEARS OF AGE IT WAS CONCLUDED THAT THERE WAS A MARKED REDUCTION IN THE SIZE OF THE PUPIL WITH AGE IN BOTH LIGHT AND DARK CONDITIONS. THE OLDER PUPIL IN PROPORTION TO INITIAL SIZE CONSTRICTED AS MUCH AS THE YOUNG IN ONE mL BRIGHTNESS.

SEVERAL investigators and clinicians have observed a tendency toward reduced pupil size in the aged (2, 3, 6, 7). An adequate study of the change in pupil size with age, however, has not been made with subjects of a wide age range. The change in pupil size with age is important since aged individuals might do poorly on visual tests as a result of reduction in the amount of light entering the eye and not because of reduced visual sensitivity (1, 4, 5). It has been shown experimentally that the effective light reaching the retina is directly proportional to the size of the pupil (6). In some studies of visual functions it is not practical to control pupil size and in such instances it would be convenient to be able to correct data for the effects of a reduction in pupil size with age.

Some observers have assumed that pupil size is a linear function of age (4, 6). This assumption is not reasonable since the pupil never has zero diameter but approaches as a limit some diameter between 2 and 3 mm. It is also unlikely that individual pupils approach this limit at the same rate.

It has been pointed out that a small pupil size in the aged may have some advantages (2). If there are small opacities in the eyes, there is less opportunity for scattering of light with a small than with a large pupil. In addition, defects of refraction and accomodation are of small importance in viewing through a pin hole aperture. Since these conditions are prevalent in the aged, the aged are at best relative advantage in viewing with a small pupil under high illumination. Such considerations should not, however, obscure the fact that age changes in pupil size can be an experimental artifact in studies of other aspects of aging of visual functions.

PROCEDURE

A Ferree-Rand perimeter was used to mount a reflex camera and flash equipment. The chin rest of the perimeter was so set that the distance from the camera lens to the iris of the eye was held constant. This distance (6 in.) was equal to twice the focal length of the camera lens; all photos were thus actual size. The fixation point in the dark was a point of red light at the center of the perimeter; in the light the fixation point was the intersection of two perpendicular black lines on a white background. The camera was mounted on the horizontal meridian 15° to the left of the fixation point. The flash discharge was from a permanent bulb with a short flash duration of about 1/5000 sec.

The subject was seated in an enclosure (4 x 5 feet) which was illuminated only by the light of the perimeter. He was adjusted to the chin rest and told to fixate the red point of light. The perimeter light was then extinguished and the subject remained in the dark for 90 sec., at the end of which time the shutter was opened (diaphragm at minimum aperture) and the flash bulb was discharged. The perimeter light was then turned on and after 90 sec. the second photograph was taken. The brightness of the neutral grey background of the perimeter was approximately 1 millilambert. Since the pupil size measurements were made under the brightness and fixation conditions of the standard perimeter, the present

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R. C. Casperson is at present a graduate student in the Department of psychology at Johns Hopkins University. He obtained his M.A. degree in 1948 from Brown University where he received his A.B. in 1947. His graduate work has been directed primarily toward human experimental research in visual perception.

Jack Botwinick received his B.A. in 1946 and M.A. in psychology in 1950 from Brooklyn College, after having served in the U. S. Army from 1943 to 1945. In 1946 he joined the Welfare Department of the City of New York and accepted his present position as psychologist with the U.S.P.H.S. in 1949. His interests lie in the measurement of intellectual deterioration in the senile and normal aged.

results may be applied to studies of age changes in size of visual fields. Pupil size was measured directly from the photographic negatives. The vertical diameter was measured with dividers and read on a millimeter scale; size was estimated to 0.1 mm.

Only the left eye was photographed for each subject unless this eye was atypical, e.g., aphacic, grossly opaque, or unable to fixate. All subjects had a measurable constriction of the pupil in response to light.

A total of 222 subjects was included in this study; of this group, 174 were white and 48 were colored. Of the total group, only 25 were female. The aged subjects were institutionalized in the Baltimore City Hospitals home for the indigent aged and the young and middle-aged subjects were 16 orderlies, 5 nurses, 39 staff members and technicians of the Baltimore City Hospitals and the U. S. Public Health Service Section on Gerontology.

The present study may have included some individuals having central nervous system syphilis, e.g., Argyll-Robertson pupils. An accumulation of individuals in the older age groups who have suffered such damage of infectious origin could bias the mean age change in pupil size. A survey of the results of serologic tests of the present population was made, therefore, to determine the extent of any bias introduced in the data by including a significant number of individuals with atypical pupils due to syphilis. Results of Eagle flocculation or Wasserman tests were obtained on 127 of the 144 individuals above the age of 50 years. Of the group tested 13, or 10 per cent, were positive. Mean pupil size values were computed for the population having negative serologic tests.

Results

A significant reduction in pupil size with age was found in the present study, for both the light and dark conditions (table 1).

Table 1. Pupil Size by Age Decades

Size in Light (1 mL.)				
Age	N	Mean Diameter mm.	σ mm.	Mean Log Area log mm.^{2}
20-29	32	5.11	0.72	1.31
30-39	20	4.64	0.70	1.23
40-49	25	4.09	0.82	1.12
50-59	32	3.77	0.80	1.05
60-69	42	3.48	0.81	0.98
70-79	36	3.52	0.70	0.99
80-89	34	3.42	0.91	0.96
Size in Dark				
Age	N	Mean Diameter mm.	σ mm.	Mean Log Area log mm.^{2}
20-29	32	7.42	0.65	1.64
30-39	20	6.72	0.90	1.55
40-49	25	5.91	1.05	1.44
50-59	32	5.89	1.09	1.44
60-69	39	4.78	1.06	1.25
70-79	36	5.10	0.80	1.31
80-89	32	4.87	1.10	1.27

The correlation ratio, η, between age and pupil size was 0.70, N = 216, for the dark, and 0.61, N = 221, for the light conditions. The change in pupil size with age was found to be curvilinear rather than rectilinear as tested by the significance of the difference between correlation ratio and product moment correlation. (P was significant at less than 1 per cent for pupil size in the dark and at 2 per cent in the light).

Because the relation was found to be curvilinear, the method of least squares was used to obtain the curve of best fit for the curvilinear regression line of pupil size against age. The data were represented by a parabola in which pupil diameter in millimeters is a function of age in years (fig. 1):

In the dark: Pupil diameter = 9.08 — 0.082 age + 0.00037 age^2

In the light: Pupil diameter = 6.38 — 0.064 age + 0.00034 age^2

A significant relation was found between size of pupil in the light and in the dark ($r = 0.83$, $N = 215$). This relation was not merely due to the concurrent reduction of pupil size with age since the partial correlation between size in the dark and light was 0.74, N = 215, when the effect of age was held constant in the data. The partial correlation, however, assumes a linear relation between pupil size and age, an erroneous assumption in this instance. The correlations between pupil size in the light and in the dark were therefore determined for each decade. By computing the average correlation after z transformation a more valid estimate of the light-dark correlation without age was obtained. This average correlation was 0.73.

No difference in pupil size was found to be associated with color of skin. When the subjects were divided according to light and dark irises in the white population, there was no difference in pupil size associated with iris pigmentation. None of the differences was significant below the 10 per cent level of probability. The lack of a pupil size difference associated with skin and iris color was true for both dark and light conditions.

About 10 per cent of the subjects above the age of 50 years had positive serologic tests for syphilis. These subjects were not, however, accumulated in the oldest decades (table 2). When the positive subjects were compared with negative subjects of the same age decade, no significant difference in pupil size was found. Since the positive subjects were not atypical when compared with subjects of the

TABLE 2. PUPIL SIZE MEASUREMENTS ON OLDER SUBJECTS GROUPED ACCORDING TO RESULTS OF SEROLOGIC TESTS FOR SYPHILIS

	Mean Pupil Diameter (in millimeters) in Negative Test Group							
Age	50-59		60-69		70-79		80-89	
	Dark	Light	Dark	Light	Dark	Light	Dark	Light
Mean	5.94	3.73	5.00	3.62	5.09	3.50	4.83	3.50
σ	1.12	0.79	0.99	0.77	0.74	0.65	1.14	0.97
N	26	26	31	34	31	31	22	23
	Mean Pupil Diameter (in millimeters) of Individual Positive Subjects*							
	6.8	4.7	4.7	2.5	6.0	4.0	3.9	2.7
	5.0	3.0	2:1	1.8	4.0	2.4	7.0	4.3
	5.5	4.0	4.0	3.2			5.9	3.5
			3.9	2.4				5.0

* As a group the subjects with serologic syphilis were not significantly different from the negative population for both pupil size in the dark and in the light, i.e., P > 10 per cent.

same age, it may be concluded that this group was not a source of significant bias in the present study.

Discussion

The present findings showed a significant change in pupil size with age, although the magnitude of the age change is not as large as might be inferred from the previous scattered observations on older persons reported in the literature. The age changes in pupil size are large enough, however, to require control or correction in studies of visual function where the illumination may be at a critical level.

The previous study most frequently cited (7) contained only 38 subjects between the ages of 16 and 84 years. Since no data were given on the number of cases per decade or on variability, it is conceivable that only one subject was observed in some of the higher age groups. Correction for age changes in pupil size using the previous data were apparently subject to considerable error (5).

The curvilinear relation of pupil size to age, demonstrated in this study, has biometric implications. It is conceivable that the total age-pupil size function would resemble a declining Gompertz curve. Such formulation of the regression equation, however, awaits an extended age range wherein the developmental as well as the involutional portions of the curve are determined.

The regression equations of the present study should not be used to predict pupil size for ages less than 20 years since there was no indication in the present data of the age of maximum pupil size.

The effect of reduced pupil size upon the minimum light threshold has already been discussed (1). The present results corroborate the opinion that the reduction in pupil size with age is not large enough to account for the total elevation in light threshold that occurs in the aged. The difference between mean pupil diameter in the dark at ages 20 to 29 and 80 to 89 was <2.6 mm.; the reduction in area is equivalent to approximately a <0.37 log. unit reduction in brightness. The difference in light threshold between such extreme age groups has been shown to be three times this value (1). Thus, while changes in pupil size with age can be expected to influence the measurement of visual functions, particularly at low brightness, its influence cannot account for the entire or even the major part of the age changes.

The ratio of the difference between pupil size in the dark and in the light to the dark size, i.e., $\frac{D^2-L^2}{D^2}$, gives an indication of the relative control of the iris over the amount of light entering the eye. Under the conditions of the present study this ratio was about 0.53 and differed by only 0.02 between the young and aged groups. Thus, in proportion to initial size, the older pupil constricted as much as the young. This apparent constant relative constriction was not anticipated in view of the fact that the older iris is typified by increases in the amount of fibrosis and hyalinization.

Summary and Conclusions

1. Measurements of pupil size were made on 222 subjects from 20 to 89 years of age. Photographs were made of the pupil under dark conditions and with a brightness of 1.0 millilambert.

2. Significant reductions in pupil size with age were found for both dark and light conditions. The mean difference in pupil size between age 20 to 29 and 80 to 89 was 2.6 mm. in the dark and 1.7 in the light. Such changes can be important in visual functions tested under conditions of critical illumination.

3. The correlation between pupil size and age was found to be curvilinear. The correlation ratio for age versus pupil size in the dark was 0.70, ($N = 216$) and 0.61 in the light. The regression of pupil size versus age was fitted by a parabola in the present data and the equations for pupil size as a function of age are presented.

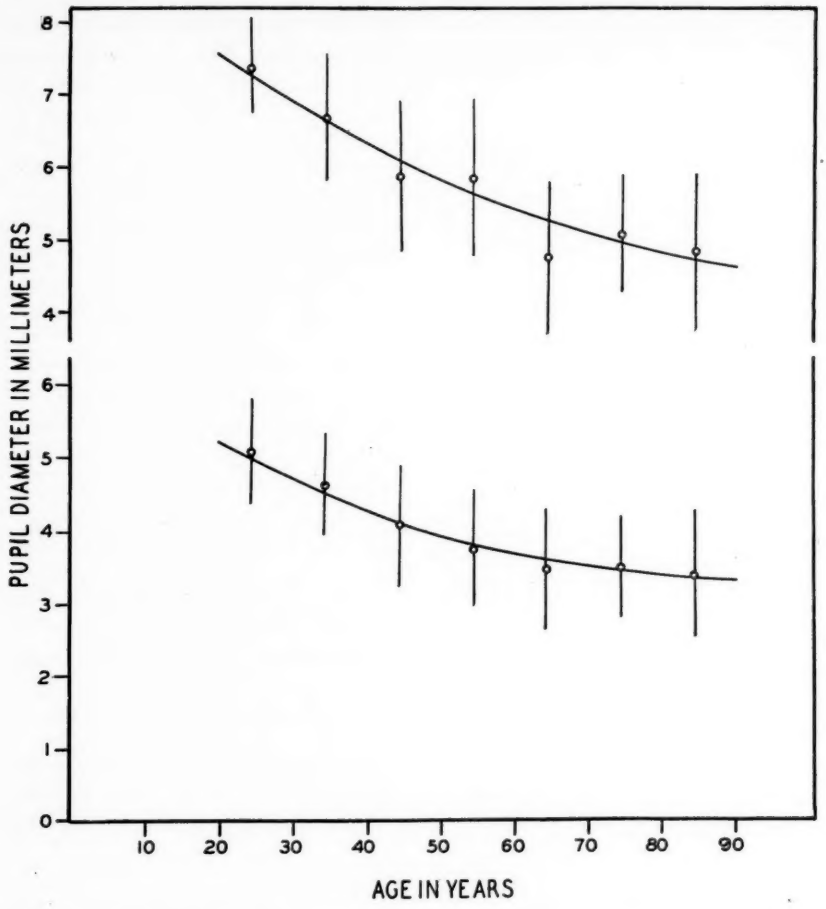

FIG. 1. Mean pupil diameter (mm.) by decades. Upper values derived from pupil size in the dark, lower values from pupil size in one mL. brightness. Vertical lines represent ± one standard deviation. Curves are regression lines derived from least square fitting.

4. No relation was found between pupil size and either iris or skin color. There was no bias apparent in the present study from the inclusion of individuals with serologic syphilis in the older age groups.

5. A significant relation between pupil size in the dark and light was found when the effect of age was held constant statistically. There is thus a tendency for an individual to maintain a characteristic level of pupil size under different conditions of brightness.

6. Pupil size decreases significantly with age and such changes must be controlled in age studies of visual functions. In instances where pupil size cannot be controlled, a correction may be introduced to account for the curvilinear relationship between age and pupil size.

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Urinary Neutral 17-Ketosteroids in the Aged

K. KOWALEWSKI

FROM A STUDY OF THE NEUTRAL 17-KETOSTEROID EXCRETION IN THE URINE OF 260 PERSONS (140 MEN AND 120 WOMEN AGED 18 TO 90) DR. KOWALEWSKI DEMONSTRATES A PROGRESSIVE DECREASE IN EXCRETION OF THESE COMPOUNDS WITH ADVANCING AGE AND POINTS OUT THE MAGNITUDE OF DAILY VARIATIONS IN THE ELIMINATION OF URINARY STEROIDS IN THE SAME INDIVIDUAL.

THE level of the androgenic substances, which are derived both from the adrenal cortex and the testes, is diminished in the aged, probably as the result of glandular involution. The elimination of the neutral 17-ketosteroids in the urine is considered an index of the combined activity of the adrenal cortex and the gonads in the male and of the adrenal cortex only in the female. The normal excretion of neutral 17-ketosteroids in the urine in a twenty-four hour period is 7 to 22 mg. in the male (mean 14 mg.) and 6 to 14 mg. in the female (mean 9 mg.).

Some authors have noted a reduction of the 17-ketosteroids excretion values in the aged but no detailed study concerning both sexes is available. Also no authors have attached sufficient importance to the daily variations which exist in the elimination of the 17-ketosteroids. A review of the literature on the subject was recently given by Kirk (3). In order to demonstrate the importance of repeated determinations of the 17-ketosteroids excretion in the same patient the results of investigations of the urinary elimination of these steroids on successive days have been added to this study (6).

MATERIAL AND METHOD

The subjects were 100 persons 60 to 90 years of age (60 men and 40 women) and 160 persons between 18 and 59 years (80 men and 80 women). None of these individuals suffered from diseases which were known to influence the 17-ketosteroid excretion. In addition to these two groups, 25 men were investigated for the daily variation of the elimination of the 17-ketosteroids; some of these subjects showed evidence of lesions of the suprarenal gland. The 17-ketosteroid determinations were performed as described by Salter, Cahen, and Sappington (8) as modified by Jayle and Libert (2).

In all the cases the twenty-four hour output of urine was obtained and conserved with the precautions mentioned by the authors of the technique employed (2, 8). From each twenty-four hour urine specimen three 100 cc. portions were analyzed for their content of the 17-ketosteroids, the final result being expressed as the mean of the 3 aliquot determinations. The difference noted between the 3 specimens of the same urine was within the range of 3 to 10 per cent. This difference is caused by the analytic error adherent to the method itself. Fraser, Forbes, Albright, Sulkowitch, and Reifenstein (1) consider the error to be about 10 to 20 per cent and were able to recover only approximately 80 per cent of the steroids added to the urine.

In the majority of the cases in the present study, the examination of the urine was made during three to five consecutive days, the final results being in each case the mean of these twenty-four hour determinations. In 25 cases, which served as the material for the study of daily variations of the 17-ketosteroids, analyses of the twenty-four hour urinary output of these substances were made during five to seven consecutive days.

RESULTS

The excretion of 17-ketosteroids in the aged —Table 1 and figure 1 illustrate the results

Dr. Kowalewski was born in Russia and attended the university in Warsaw, Poland, where he obtained his Ph.M. in 1935 and joined the faculty of medicine. From 1939 to 1945 he was a prisoner of war in Germany. He received his M.D. and Ph.D. degrees from Brussels University in 1947. Since then Dr. Kowalewski has been attached to the Research Laboratory in the Brugmann Hospital, Medical Clinic of Brussels University.

obtained in the 100 old and 160 younger individuals. The data show that the excretion of the 17-ketosteroids in the urine is markedly reduced in the old individuals, the average value being 5.58 mg. in the men and 6.60 mg. in the women. The corresponding values for the younger subjects were 12.17 and 9.50 mg. respectively.

The daily variation in the excretion of 17-ketosteroids.—The results obtained in the 25

TABLE 1. STATISTICAL STUDY OF THE VALUES OF NEUTRAL 17-KETOSTEROIDS FOUND IN 100 AGED AND 160 YOUNGER PATIENTS (17-KETOSTEROIDS IN MG. PER TWENTY-FOUR HOURS)

Number of Cases	Sex	Age	Mean	Standard Deviation	Coefficient of Variation	Range
80	Male	18-59	12.17	2.78	22.81	6.6-18.7
80	Female	18-59	9.50	2.28	24.00	6.1-16.5
60	Male	60-89	5.58	1.39	24.90	4.1-11.5
40	Female	60-89	5.60	1.16	20.70	4.0- 8.7

TABLE 2. VARIATIONS IN THE ELIMINATION OF NEUTRAL 17-KETOSTEROIDS AS FOUND IN 25 MALES (17-KETOSTEROIDS IN MG. PER TWENTY-FOUR HOURS)

Number	Age	Days							Mean	Standard Deviation	Coefficient of Variation %	Range
		1	2	3	4	5	6	7				
1	28	3.95	4.36	4.19	4.90	5.16	4.11	3.20	4.27	0.81	18.94	3.95- 5.16
2	75	5.65		4.12	4.71		5.10	3.90	4.68	0.72	15.34	3.90- 5.65
3	87	4.91	4.12		5.33	6.13		4.21	4.94	0.83	16.80	4.12- 6.13
4	60	4.10	6.15		5.83	4.90	4.72		5.10	0.84	16.47	4.10- 6.15
5	46	5.15	4.15	4.25	7.07	5.73	4.33	5.15	5.15	1.01	19.61	4.15- 7.07
6	84	6.16		5.14	4.90		6.82	5.30	5.68	0.95	18.50	4.90- 6.82
7	45	7.85	6.31	6.70	5.90	4.99	6.13	6.35	6.19	0.91	14.70	4.99- 7.85
8	75	6.31	7.00	6.48	5.18	7.25	5.08	7.90	6.47	0.94	14.52	5.08- 7.90
9	72	7.31			5.21	6.33	6.20	7.14	6.84	0.95	13.90	5.21- 7.31
10	45	6.88	9.31	9.30	6.31	5.90	6.90	7.60	7.34	1.25	17.03	5.90- 9.31
11	51	8.32	8.10	12.21	9.50	7.47	8.40	7.90	8.44	1.58	15.60	7.47-12.21
12	31	8.05	7.90	8.50	8.42	7.25	11.20	8.64	8.56	1.25	14.70	7.25-11.20
13	51	8.20	8.11	9.25	12.40	7.30	9.12	10.10	9.23	1.65	17.88	7.30-12.40
14	50	9.10	13.20	9.89	7.37	10.00	11.30	9.70	10.08	1.82	18.05	7.37-13.20
15	35	11.20	10.31	11.50	9.75	15.20	8.40	10.60	10.99	2.13	19.38	8.40-15.20
16	44	8.64	11.50	9.14	15.60	9.50	10.79	11.17	10.90	3.16	28.99	8.64-15.60
17	47	10.16	11.23	8.70	15.31	11.76	9.70	9.90	10.97	2.27	27.11	8.70-15.31
18	23	11.35	9.75	15.40	10.11	8.31	14.20	9.30	11.20	2.83	25.02	8.31-15.40
19	19	9.26	11.16	8.34	14.11	10.22	13.10	15.34	11.67	2.87	24.58	8.54-15.34
20	52	9.31	10.56	13.50	9.85	15.21	10.30	16.17	12.11	2.74	22.62	9.31-16.17
21	48	15.40	14.15	12.50	9.11	12.35	9.90	12.45	12.26	2.25	18.35	9.11-15.42
22	35	14.70	16.40	13.30	9.70	10.32	13.26	13.73	13.06	2.36	18.07	9.70-16.40
23	22	14.24	17.33	15.17	18.30	15.10	14.35	14.11	15.51	1.93	12.44	14.11-18.30
24	37	16.15	15.30	20.14	19.21	15.25	19.25	18.10	17.48	2.03	11.60	15.25-20.14
25	26	23.33	30.50	26.35	24.42	35.60	32.15	28.11	28.63	4.63	16.13	23.35-35.60

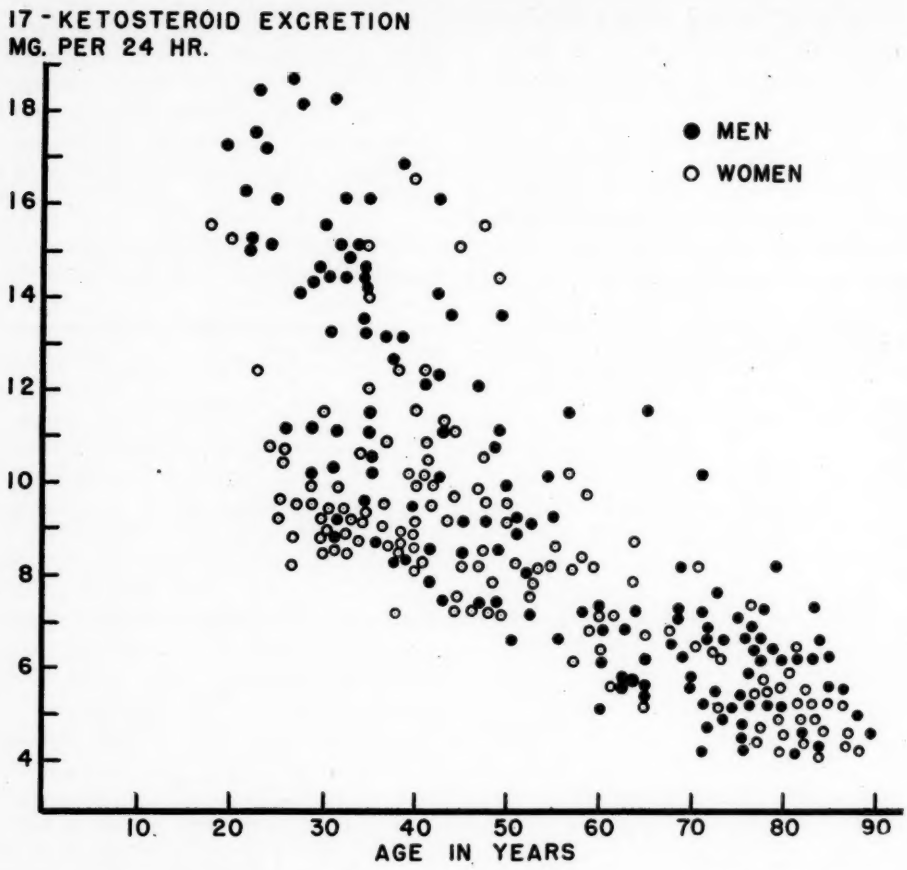

FIG. 1. Distribution of the values of urinary neutral 17-ketosteroids (in mg. per twenty-four hours) as a function of age.

men whose urine was examined over a period of five to seven days are presented in table 2. The figures show a considerable variation from day to day, the difference even exceeding 60 per cent (for example, case No. 13, table 2). The standard deviation in the majority of the cases exceeded 2 mg.

DISCUSSION

In many instances the clinician is content with the results of a single determination of the 17-ketosteroids in a twenty-four hour specimen of urine. The indisputable existence of daily variations in the elimination of the urinary steroids demonstrated in this investigation shows clearly that it is necessary to repeat the examinations of the urine if one wishes to have results of real clinical value.

The fluctuations in the elimination of the urinary steroids from one day to the other are less in patients whose output of these substances is low. Such reduced excretion is noted in cases No. 1 to 9 (table 2). Three of these (Nos. 1, 5, and 7) were patients with far advanced pulmonary tuberculosis, Addison's disease being present in case No. 1. Patients Nos. 2, 3, 4, 6, 8, and 9 were admitted with the diagnosis of senility. The values of

the 17-ketosteroids in aged persons were in the range of the values obtained in the cases suspected of having a pathologic condition in the suprarenal gland. The standard deviation in the patients presenting a diminution of the 17-ketosteroids in the urine was 1 mg. or less. Those with normal and elevated values (for instance, No. 25) have greater daily variations with their standard deviations often exceeding 2 mg.

It is probable that in the cases where the production of androgenic hormones is diminished the fluctuations in the elimination of the urinary steroids is less. In the aged person, as noticed in many cases, these fluctuations are less than in the younger age group.

Results in this study of the elimination of the 17-ketosteroids in the aged show a progressive diminution of the steroids in the urine with advancing years (see fig. 1). This diminution has also been noted by other authors (1, 3, 7).

In the male both testicular and adrenocortic hypofunction can cause this diminution. The testes and the adrenal cortex can compensate one for the other; this is observed, for instance, in Addison's disease, the cortical deficiency being rapidly compensated for by the augmented activity of the testes as regards the elimination of the urinary 17-ketosteroids (8). In the aged male this compensatory mechanism is rendered difficult because of the fact that both organs are in a state of involution. In the female it is only the involution of the adrenal cortex which can provoke the diminution of the 17-ketosteroids in the urine. As the aged women examined in this investigation show a diminution of urinary 17-ketosteroid excretion it can be concluded that involution of the adrenal cortex takes place in the aged of both sexes. These observations are in agreement with the work of Korenchevsky concerning the involution of the endocrine system during aging (4, 5).

In conclusion it can be said that the diminution of the urinary 17-ketosteroid excretion noted in the aged is probably the result of the senile involution of the organs producing the urinary androgens, the gonads and the adrenal cortex of the male and the adrenal cortex alone in the female. The study of the 17-ketosteroids can serve as an adjunct in the diagnosis of hypofunction of these organs.

Summary

A study of the elimination in the urine of the 17-ketosteroids was made in 260 patients, 100 of these being in the older age group (above 60 years). In addition, 25 other persons were studied over a period of five to seven consecutive days in order to establish the daily variation in the elimination of these substances, and the important fluctuations from one day to the other were noted. The diminution of the 17-ketosteroids in the urine progressing with age has been demonstrated. The role of the organs responsible for the production of the 17-ketosteroids excreted in the urine is discussed.

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Stability of Body Function in the Aged

I. Effect of Exposure of the Body to Cold

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OBSERVATIONS ON 13 ELDERLY AND 6 YOUNG SUBJECTS INDICATE THAT WHEN EXPOSED TO COLD THE RESULTING INCREASE IN OXYGEN CONSUMPTION IS GREATER IN THE OLD THAN IN THE YOUNG. THE MECHANISMS FOR PREVENTION OF HEAT LOSS ARE HOWEVER LESS EFFICIENT IN THE OLDER THAN IN THE YOUNGER PEOPLE.

THE response of elderly individuals to exercise, drugs, infections, trauma, heat, and cold is usually considered to be different from that of younger individuals. For this reason an investigation of the response of elderly individuals to various stimuli was considered of interest in order to evaluate the stability of the aged body. In this report the effect of cold upon the changes in body temperature and oxygen consumption has been studied.

Previous investigations (1, 2, 4, 5, 8, 11, 12) on the effect of cold on younger individuals have shown that the responses form a regular pattern both with regard to oxygen consumption and the maintenance of body temperature. Exposure to cold has the effect of increasing supplementary muscle contraction which increases the heat production of the body and consequently the rate of oxygen consumption.

A second response is the vasomotor constriction of the skin which decreases heat loss. Disturbances in either of these two mechanisms, muscular activity or vasoconstriction of the skin, may result in the body being unable to maintain its usual temperature even under mild exposure to cold. Such disturbances are frequently seen following coma due to anesthesia, alcoholic intoxication, and drugs such as the barbiturates (14). In animal experiments it has been found that thyroid or adrenal cortical insufficiency (6, 10), section of the spinal cord, or paralysis of the skeletal muscles by the action of curare (14) may be associated with similar deficient responses to cold.

According to Cannon (3) in old age there may be a decreased ability to withstand cold apparently because of decreased heat production. It is usually believed that older individuals complain of chilliness more readily than do younger ones and that they frequently require more clothing than younger people. The oxygen consumption of aged individuals has been observed to be higher in debilitated subjects than in the nondebilitated (7). Munk (9) in 1910 reported that elderly subjects immersed in water shivered when the temperature of the bath water was reduced while under the same circumstance the younger controls did not. On the whole, however, one finds in the literature little information concerning the ability of aged individuals to maintain body temperature when exposed to cold.

METHOD

Observations were made upon 13 subjects between the ages of 57 and 91 years and 6 young, healthy subjects 22 to 36 years of age. The aged subjects were patients in the St. Louis City Infirmary Hospital for many months and the young controls were employee volunteers. All subjects had been well evaluated prior to study, including physical examinations, chest roentgenograms, electrocardiograms, chemical blood analyses, blood counts, urinalyses, and determinations of metabolic rates. None of the subjects showed any evidence of acute illness or cardiac decompensation at the time of exposure, but all of the aged subjects suffered from various degenerative diseases such as arteriosclerosis, hypertrophic arthritis, osteoporosis, and senile mental deterioration (table 2).

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The aged subjects were divided into 4 groups, depending upon the degree of debilitation, which was based upon clinical observations as judged by activity in the ward, state of nutrition, severity of the chronic illness responsible for admission to the institution, and the general condition through the previous year. In general, classification was as follows: 1+, active and ambulatory; 2+, weak but ambulatory; 3+, inactive, and requiring assistance in walking; 4+, the most inactive and weak. None of the patients were bedfast.

Observations were made while the subjects were under fasting basal conditions. Immediately before exposure to the cold, oxygen consumption, and oral, rectal, and surface temperatures were recorded. The subjects were placed unclothed in a Burdick fever cabinet which had been converted into a refrigerating unit delivering an air temperature of 5 to 15 C. Serial observations were recorded by means of iron-constantine thermocouples of the rectal temperature and the surface temperature of the abdomen, midback, and midpoint of the lower arm and leg. Serial determinations were also made of the oxygen consumption by standard clinical closed circuit appartus, and the results were expressed in terms of percentage of normal by use of the Du Bois standard tables, as modified by Boothby and Sandiford. Each subject was encouraged to remain in the cabinet for 120 minutes; however, some of the subjects became too uncomfortable or a marked fall in rectal temperature occurred which prevented exposure for this length of time. All subjects were able to remain in the cabinet for at least 45 minutes.

The technique used in this study was not absolutely accurate from the point of view that in order to expose each subject to the same degree of cold it is necessary to equate the body variables such as weight and height to the air temperature, humidity, and air movement. This would have necessitated control of air temperature at closer limits than was possible with our equipment. The temperature and humidity in the cabinet was partly dependent on the room temperature and humidity. The room temperature could not be closely controlled and varied from 60 to 70 F. during the winter while the study was conducted. For these reasons it was not possible to expose all subjects in an identical manner. It was found, however, that when one point, such as the midpoint of the lower leg, was taken as a constant point for surface temperature, the temperature and rate of temperature change was quite similar for all subjects. This indicates that the degree of exposure to cold was approximately equal for all subjects.

Results

Upon first entering the cabinet all subjects stated that they felt chilly. Certain of the young individuals developed an aching sensation in their back caused by increased muscle tonus and tremor. Paroxysms of rather vigorous shivering followed, and certain of the young (Nos. 4, 5, 6), but none of the elderly,

had considerable discomfort. Even one elderly debilitated subject (No. 10), whose body temperature dropped considerably, experienced no body distress and only mild shivering. Some of the younger individuals complained of chilliness during the remainder of the day but felt well the next day. All of the older subjects had a hot drink and none complained of chilliness later in the day.

In our studies the onset of shivering was not necessarily related to a change in the rectal or surface temperature. Our results differed from those of Spealman (12) in which he indicated that the onset of shivering occurred with a rectal temperature of 36.0 C. We found in our studies that in both young and old individuals the rectal temperature was frequently above 37.0 C. when noticeable shivering occurred. In the older individuals shivering did not necessarily occur even after the rectal temperature was reduced below 36.0 C. The results of Swift (13) showing the onset of shivering when the surface temperature became 17.0 C. could not be confirmed in these aged subjects. This may, however, be caused by a difference in the location at which the surface temperature was measured. In our experiments shivering occurred usually before the temperature at the midpoint of the lower leg was as low as 20.0 C.

During the total period of cold exposure the increase in respiratory rate was only one or two respirations per minute; however during the paroxysms of shivering there was a temporary increase in respiratory rate which could not be measured with accuracy. The heart rate also showed little change during cold exposure, and in the older subjects the average rate was only increased 5 beats per minute, whereas in the young it was slightly less.

Upon exposure to cold the changes in rectal temperature and oxygen consumption showed rather wide individual variation both in the young and old. The individual responses of each subject are shown in figures 1 and 2 and table 3.

Among the young subjects (fig. 1) little change in rectal temperature occurred (less than 0.5 C.). In contrast to this 10 of the 13 elderly subjects (fig. 2) had a fall in rectal temperature of 0.5 C. or more and of these 5 had a fall of 1.0 C. or more (Nos. 7, 9, 10, 14, 15).

Expression of the oxygen consumption in terms of percentage of normal, as is usually done when determining the basal metabolic rate, was selected as a method of expressing graphically the changes in metabolic rate following the cold exposure. Using this method of expression it may be seen (fig. 1) that only 3 (Nos. 4, 5, 6) of the 6 young subjects showed an increased oxygen consumption. The maximum increased values were +85, +110, and +95 per cent and were higher than in any of the aged subjects (fig. 2) except for one (No. 14) who had a value of +100 per cent. Whereas, in the young individuals, markedly increased oxygen consumption occurred with a change in rectal temperature of only 0.5 C., of the 10 elderly subjects whose rectal temperature fell 0.5 C. or more 5 failed to show an increase in oxygen consumption more than +50 per cent (Nos. 9, 10, 11, 12, 16). Only one aged subject showed a rise in oxygen consumption of more than 70 per cent (No. 14).

The onset of increased oxygen consumption was, however, more rapid in the older than in the younger individuals. Thus, at the end of the first 15 minute period only a small rise had occurred in the young subjects, whereas in that period 7 out of 10 old subjects (Nos. 7, 8, 11, 16, 17, 18, 19) already had reached a maximum or nearly maximum increase. Mean values at 15 and 30 minutes of exposure for the aged subjects were +29 and +31 per cent and for the young +4 and +12 per cent.

Expression of the oxygen consumption in terms of cubic centimeter of oxygen consumed per square meter of surface area is a more direct method of expression than per cent of normal and excludes the effects of age. Calculation of the amount of oxygen consumed at the end of various time intervals was carried out by plotting the rate per minute values on graph paper and measuring the area delimited by the curve. The data for each subject are

presented in table 3 and are expressed in terms of cubic centimeter oxygen consumed per square meter of surface area at the end of 15, 45, 60, 75, and 90 minutes of exposure to cold. Both the values for the basal oxygen consumption and the increase following exposure to cold are presented in the table together with statistical evaluation of the figures.

That the basal oxygen consumption (basal metabolic rate) decreases with age is well known and the data presented here (table 3) is in line with this observation. The "t" values are given in brackets.

The table reveals the interesting finding that the mean increase in oxygen consumption following cold exposure was significantly higher in the old than in the young individuals. The increased oxygen consumption in the aged was most pronounced at the end of the 15, 30, and 60 minute periods, highly significant statistical differences being evident. Less evident differences were present at the end of the 45, 75, and 90 minute periods.

No relationship could be demonstrated between the clinical condition of the old patients and the adequacy of response to cold exposure. Of the 5 subjects whose rectal temperature fell 1.0 C. or more, 3 were considered definitely debilitated (Nos. 7, 10, 14) and the other 2 (Nos. 9, 15) in fairly good health. Of the aged subjects only one (No. 14) had a maximal increase in rate of oxygen consumption as high as the young and this subject was moderately debilitated. Likewise no significant difference in cubic centimeter of oxygen consumed per square meter surface area could be demonstrated between the debilitated and nondebilitated aged subjects or between those whose rectal temperature decreased by 1.0 C. or more and those whose rectal temperature decreased less than 1.0 C.

Conclusions

Comparison of the effects of cold exposure on aged and young subjects reveals that the aged subjects were less able to maintain their body temperature than the young. The increased oxygen consumption that normally results from exposure to cold was found to be present in both young and old. This increased oxygen consumption, however, is higher in the aged, particularly during the first 30 minutes of cold exposure. The more rapid onset of increased oxygen consumption in the aged would suggest that the mechanisms for prevention of heat loss were less efficient in the aged than in the young; consequently heat production occurs earlier during the course of cold exposure.

The results of this study indicate that the aged are capable of increasing heat production to high levels. In spite of this great increase of heat production of the aged, the rectal temperature falls when compared to younger individuals. It cannot be shown from the data available whether this is caused by impaired functioning of the mechanisms for the prevention of heat loss alone or by an inability to cause a further increase in heat production. No correlation could be demonstrated in the aged between those who were debilitated and those who were not; nor could any differences in oxygen consumption be demonstrated between those whose rectal temperature decreased more than 1.0 C. and those less than 1.0 C.

Table 1. Young Control Subjects Exposed to Cold

Subject No.	Sex	Age	Height	Weight in Pounds	Percentage of Ideal Weight
1.	Female	24	5′ 8½″	176	120
2.	Male	22	5′ 10″	165	107
3.	Male	36	5′ 11½″	219	135
4.	Male	22	5′ 10½″	134	85.5
5.	Female	36	5′ 5″	154	121
6.	Female	26	5′ 5½″	150	114

Summary

Thirteen aged subjects 57 to 91 years of age and 6 young control subjects 22 to 36 years of age were exposed to cold (5 to 15 C.) for a period of 45 to 120 minutes, unclothed and motionless. Rectal temperature, surface tem-

TABLE 2. AGED SUBJECTS EXPOSED TO COLD

Number	Sex	Age in Years	Height	Weight in Pounds	Percentage of Ideal Weight*	Clinical Findings	Comments	Degree of debilitation
7.	Female	91	5′ 1″	88¼	80.9	Senile psychosis, old hip fracture, arteriosclerotic heart disease, kyphosis, senile emphysema	Walks only with assistance, weak, inactive, poorly nourished	4+
8.	Female	86	4′ 10½″	98	101.4	Old hip fracture, degenerative arthritis, kyphosis, senile emphysema, aortic enlargement	Walks only with assistance, weak, inactive, poorly nourished	4+
9.	Female	82	4′ 11½″	145	143	Senile psychosis	Well nourished, active, ambulatory	1+
10.	Male	78	5′ 11½″	170	105	Traumatic arthritis of hip, old hip fracture, aortic enlargement, positive Kahn test	Walks only with crutches, weak, inactive	3+
11.	Male	78	5′ 8½″	132	90	Degenerative arthritis, generalized arteriosclerosis, arteriosclerotic heart disease	Thin, active, walks with crutches	2+
12.	Male	77	5′ 6″	137	102	Traumatic arthritis of hips and shoulders, generalized arteriosclerosis	Walks only with assistance, weak, inactive	3+
13.	Male	77	5′ 7½″	149	105	Arteriosclerotic heart disease	Well nourished, active, ambulatory	1+
14.	Male	73	5′ 4¼″	131	103.5	Old hip fracture, generalized arteriosclerosis, senile psychosis, kyphosis	Walks only with assistance, weak, inactive	3+
15.	Male	68	5′ 3½″	115	96	Senile psychosis, arteriosclerotic heart disease	Well nourished, active, ambulatory	1+
16.	Female	67	5′ 7½″	139	98	Psychoneurosis, arteriosclerotic heart disease	Fairly well nourished, ambulatory, inactive	2+
17.	Female	61	4′ 11″	111	112	Senile psychosis	Poorly nourished, weak, ambulatory	2+
18.	Female	57	5′ 1″	131	120	Feeble minded, kyphoscoliosis	Strong, active, well nourished	1+
19.	Female	57	5′ 2″	125	110	Psychosis	Strong, active, well nourished	1+

* These values are only approximate due to shortening of the spine. Percentage of ideal weight calculated from Broca's Formula (Height in cm. —100) x 0.9 ÷ 100.

TABLE 3. OXYGEN CONSUMPTION OF YOUNG AND OLD SUBJECTS

Subject Number	Surface Area in Square Meters	cc. Oxygen per Square Meter of Surface Area Consumed at the End of Various Time Intervals											
		15 Minutes		30 Minutes		45 Minutes		60 Minutes		75 Minutes		90 Minutes	
		Basal Consumption	Increase Above Basal	Basal Consumption	Increase Above Basal	Basal Consumption	Increase Above Basal	Basal Consumption	Increase Above Basal	Basal Consumption	Increase Above Basal	Basal Consumption	Increase Above Basal
Controls													
1	1.93	1,710	117	3,420	387	5,130	669	6,840	744	8,520	744	10,185	744
2	1.92	1,953	78	3,906	195	5,862	234	7,812	312	9,765	359	11,643	359
3	2.19	1,917	69	3,834	378	5,754	753	7,671	999	9,588	1,239	11,508	1,479
4	1.75	1,842	129	3,684	729	5,529	2,184						
5	1.75	1,800	138	3,600	624	5,400	1,836						
6	1.75	1,671	171	3,342	480	5,013	738	6,687	1,311	8,349	2,427	10,032	3,927
Mean		1,815	117	3,631	466	5,448	1,069	7,252	841	9,055	1,192	10,842	1,627
Standard Deviation		111	38	223	191	336	761	571	422	724	898	851	1,602
Standard Error		45	16	91	76	137	311	285	211	362	449	425	801
Aged													
7	1.32	1,818	273	3,636	774	5,454	1,296	7,272	1,920	9,093	2,556	10,908	3,171
8	1.35	1,446	333	2,892	1,389	4,329	2,490	5,772	3,420	7,224	4,368		
9	1.61	1,398	234	2,796	840	4,191	1,398						
10	1.96	1,608	114	3,216	375	4,824	657	6,429	903				
11	1.71	1,578	351	3,156	1,653	4,740	1,824	6,318	2,580				
12	1.68	1,698	162	3,396	339	5,088	474	6,786	615	8,464	867	10,179	1,206
13	1.78	1,602	102	3,204	270	4,803	471	6,405	708	8,004	945	9,609	1,323
14	1.61	1,398	465	2,796	1,863	4,194	3,540						
15	1.66	1,536	360	3,072	741	4,608	2,160	6,147	3,516	7,680	3,737		
16	1.72	1,605	366	3,210	996	4,839	1,569	6,453	2,094	8,067	2,703	9,681	3,402
17	1.43	1,731	261	3,462	786	5,193	1,302	6,924	1,929	8,512	2,139	10,134	2,139
18	1.57	1,482	381	2,964	1,050	4,443	1,566	5,925	1,998	7,395	2,427	8,886	2,952
19	1.54	1,560	486	3,120	1,560	4,677	2,688	6,231	3,720	7,794	4,734		
Mean		1,574	299	3,148	972	4,721	1,648	6,424	2,127	8,026	2,719	9,900	2,365
Standard Deviation		127	122	252	530	380	902	436	1,108	590	1,362	679	953
Standard Error		35	34	70	147	106	250	131	334	198	454	278	389
"t" Test		[4.20]	4.92	[4.20]	3.04	[4.20]	1.45	[2.64]	3.48	[2.50]	2.39	[1.85]	0.82

TABLE 3. OXYGEN CONSUMPTION OF YOUNG AND OLD SUBJECTS (Continued)

Subject Number	Surface Area in Square Meters	cc. Oxygen per Square Meter of Surface Area Consumed at the End of Various Time Intervals											
		15 Minutes		30 Minutes		45 Minutes		60 Minutes		75 Minutes		90 Minutes	
		Basal Consumption	Increase Above Basal	Basal Consumption	Increase Above Basal	Basal Consumption	Increase Above Basal	Basal Consumption	Increase Above Basal	Basal Consumption	Increase Above Basal	Basal Consumption	Increase Above Basal
Debilitated (Nos. 7, 8, 10, 12, 14)													
Mean		1,594	269	3,187	948	4,778	1,691	6,565	1,714	8,260	2,597	10,543	2,188
Standard Deviation		174	140	348	663	525	1,301	631	1,267	951	1,751	515	1,390
Standard Error		78	60	156	297	235	581	316	633	549	1,011	365	983
Non-debilitated (Nos. 9, 11, 13, 15, 16, 17, 18, 19)													
Mean		1,562	318	3,123	987	4,687	1,622	6,343	2,364	7,909	2,781	9,577	2,454
Standard Deviation		97	116	194	449	295	649	311	1,030	381	1,284	516	917
Standard Error		34	41	69	170	104	229	117	389	155	524	258	459
"t" Test		0.4	0.7	0.4	0.1	0.3	0.1	0.7	0.9	0.6	0.2	2.2	1.4
Rectal Temperature Decrease of More Than 1.0 C. (Nos. 7, 9, 10, 14, 15)													
Mean		1,552	289	3,103	919	4,654	1,810	6,616	2,113	8,386	3,146	(10,908)	(3,171)
Standard Deviation		174	132	349	558	524	1,103	585	1,317	999	835		
Standard Error		78	59	156	250	234	493	338	743	707	590		
Rectal Temperature Decrease of Less than 1.0 C. (Nos. 8, 11, 12, 13, 16, 17, 18, 19)													
Mean		1,588	305	3,175	1,005	4,764	1,548	6,352	2,133	7,923	2,598	9,698	2,204
Standard Deviation		96	124	193	522	292	814	390	981	492	1,616	522	971
Standard Error		34	44	68	185	103	288	138	347	186	610	239	434
"t" Test		0.4	0.2	0.4	0.3	0.4	0.5	0.7	0.0	0.6	0.6		

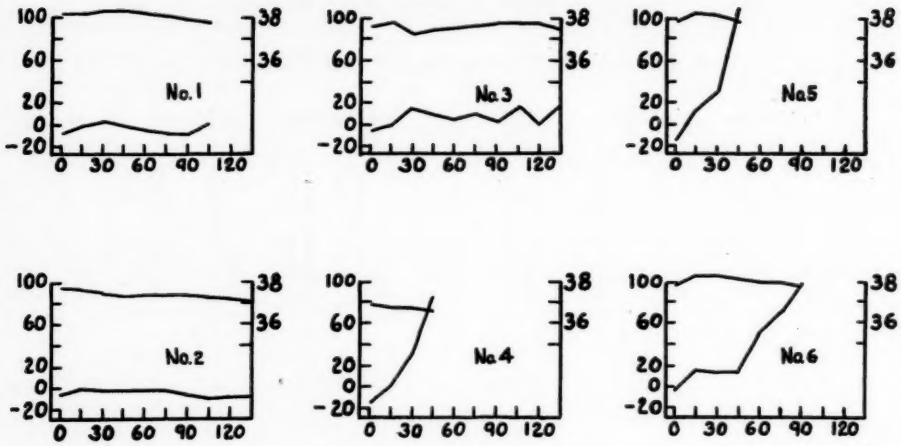

FIG. 1. Young Subjects Exposed to Cold. The upper line represents rectal temperature in degrees Centigrade and the lower line oxygen consumption in percentage of normal. Time is expressed in minutes.

perature, pulse rate, respiration, and oxygen consumption were measured before and during the exposure. The results indicate that although the aged withstood the exposure fairly well and with less discomfort than the young, they were less able to maintain their body temperature than the young subjects. An earlier onset and a greater increase of oxygen consumption in the aged was observed.

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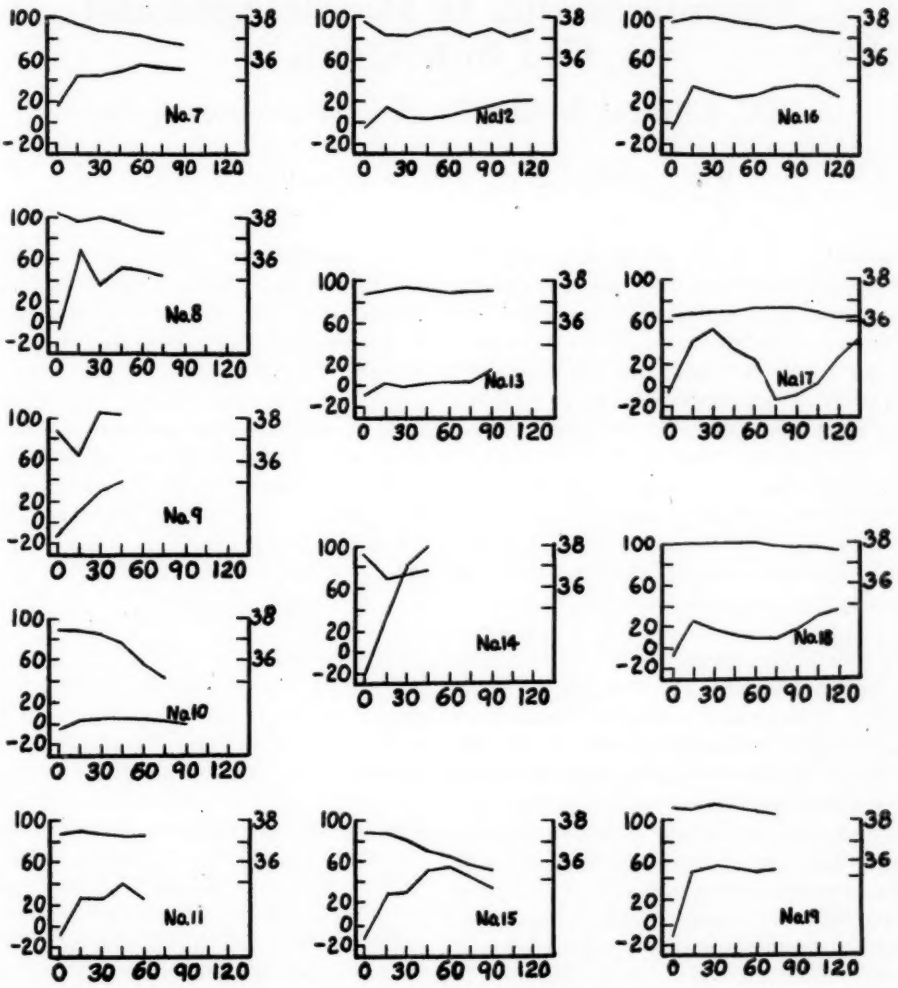

FIG. 2. Aged Subjects Exposed to Cold. The upper line represents rectal temperature in degrees Centigrade and the lower line oxygen consumption in percentage of normal. Time is expressed in minutes.

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Vitamin Studies In Middle-Aged and Old Individuals

IV. Clinical Studies In Hypovitaminemia B_1

JOHN ESBEN KIRK AND MARGARET CHIEFFI

A CLINICAL STUDY OF 42 MIDDLE-AGED AND OLD INDIVIDUALS WITH LOW BLOOD THIAMINE VALUES AND 26 SUBJECTS WITH NORMAL BLOOD VITAMIN CONCENTRATION SHOWED A SIGNIFICANTLY GREATER INCIDENCE OF IMPAIRED VIBRATORY SENSE, TENDERNESS OF THE CALVES, AND EDEMA OF THE LEGS IN THE VITAMIN DEFICIENT GROUP. THIS PAPER WAS GIVEN AT THE INSTITUTE ON PROBLEMS OF AGING AT WASHINGTON UNIVERSITY, ST. LOUIS, APRIL 11-12, 1949, AND AT THE SECOND ANNUAL SCIENTIFIC MEETING OF THE GERONTOLOGICAL SOCIETY IN CHICAGO, NOVEMBER 5-6, 1949.

THE literature concerning the clinical aspects of thiamine deficiency in man is rather extensive. The general contention seems to be that although the clinical picture of the fully developed condition of beriberi is well defined, the symptoms and signs associated with the less severe degrees of thiamine depletion are somewhat vague and uncharacteristic. The difficulty associated with a diagnosis of moderately severe states of thiamine deficiency is further enhanced by the frequent occurrence of other dietary deficiencies. In spite of this the reports of various clinicians are in fair agreement concerning the findings in thiamine deficiency. The most reliable information on the symptomatology of moderately severe thiamine depletion seems to have been provided during the past few years by studies in which thiamine deficiency was produced experimentally by prolonged administration of a diet with a low thiamine content (Horwitt, Liebert, Kreisler, and Wittman, 6). The results obtained from such studies agree well with the symptomatology observed in those conditions in which a state of thiamine deficiency has been inferred.

No investigations have as yet been reported on the correlation between the blood thiamine concentration and clinical signs and symptoms in a larger group of middle-aged and old individuals. As the thiamine content of the blood may be presumed to offer a measure of the state of thiamine nutrition, such an investigation might contribute to the evaluation of the symptomatology of thiamine depletion in these age groups. The present publication reports the results of such studies.

EXPERIMENTAL

The investigation was carried out on 42 individuals who on examination were found to have thiamine blood values below 2.0 micrograms per cent and 26 individuals with a blood thiamine concentration above 3.5 micrograms per cent. All the subjects were between the ages of 50 and 101 years and were inmates of the St. Louis City Infirmary. The mean age of the hypovitaminemic individuals was 71 years and of the patients with normal blood thiamine values 68 years. Patients with hypertension or cardiac failure and individuals with diseases which in themselves might be expected to produce symptoms similar to those generally ascribed to thiamine deficiency were not included in the study.

The diet of the institution at the time of study was calculated to contain an average of 2.150 calories, 265 Gm. of carbohydrate, 110 Gm. of protein, 69 Gm. of fat, and 1.9 mg. of thiamine daily. Direct determinations of the thiamine content of the prepared food were also made by a modification of the fluorometric method of Hennessy and Cerecedo as described by Hawk, Oser, and Summerson (5). The

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His primary fields of research have been in clinical medicine and biochemistry. He is a member of the American and Danish Gerontological Societies and the Danish Society of Internal Medicine, a member of the Harvey Society, and a Fellow of the Royal Society of Medicine, England.

Dr. Chieffi is Research Assistant at the Division of Gerontology, Washington University School of Medicine. She obtained her M.D. degree from the University of New Zealand in 1938 and from 1940 to 1946 was on the staff of the Forlanini Hospital of the University of Rome. She was authorized as a specialist in chest diseases in 1944 and held the position as Instructor in Pulmonary Diseases at the University of Rome from 1944 to 1946. Her chief interests are in the fields of chest diseases and gerontology.

average daily thiamine content of the food was found on analysis to be 1.5 mg.

The blood thiamine determinations were performed by the method of Friedemann and Kmieciak (3) as described in a previous communication (8).

In the selection of symptoms and signs, 11 symptoms and 43 signs were chosen which in the reports in the literature have been described as being associated with thiamine deficiency. Fluorescence of the tongue when exposed to Wood's light (365 $\mu\mu$) was also noted, since preliminary reports by Hagerman and Hirschfeld (4) have suggested an association between an absence of normal orange fluorescence of the tongue and vitamin B deficiency.

The signs and symptoms chosen for study are listed in table 1. In addition to those listed in the table other clinical investigations were carried out.

Since cardiac enlargement had been noted in experimental thiamine deficiency (Street, Zimmerman, Cowgill, Hebbel, and Fox, 11) it was thought of interest to compare the mean cardiac area of the individuals in the two groups. Teleroentgenography was employed to obtain the heart shadow and the cardiac area was calculated as a percentage of the estimated normal for the subject. For determination of the normal frontal area of the heart as predicted from the height and weight of the individual the nomogram compiled by White (12) was used.

Analyses of the gastric contents were carried out by the method of Töpfer as described by Kolmer and Boerner (9) to determine the presence or absence of free hydrochloric acid in the gastric secretion, since thiamine is reported to be destroyed in an alkaline medium. Thus Melnick, Robinson, and Field (10) have shown that when thiamine is incubated in vitro for 16 hours with human bile or pancreatic juice 50 per cent may be destroyed, whereas there is no significant destruction of the vitamin when it is incubated with normal gastric juice.

The state of nutrition of the individuals was estimated by calculating the actual body weight as a percentage of the ideal body weight using Broca's formula:

$$\text{Ideal weight}: \frac{\text{Height in cm} - 100}{100} \times 90$$

Results

In table 1 is given the percentage frequency of occurrence of the various signs and symptoms in the individuals with low and normal thiamine blood levels and also a calculation of the statistical significance of the difference noted. It will be seen that general fatigue, weakness and heaviness of the legs, redness and fissures of the tongue, blepharoconjunctivitis, conjunctival thickening, impaired vibratory sense of the lower extremities, tenderness

of the calves, and edema of the legs occurred with significantly greater frequency in the group having low blood thiamine concentrations.

In connection with the enumeration of the neuromuscular findings it should be mentioned that, as shown in a previous study (Chieffi and Kirk, 1) motor chronaxie determinations offer little help in the clinical diagnosis of moderately severe thiamine deficiency.

The edema of the legs, which occurred with considerably greater frequency in the group with low blood thiamine values, was not associated with any reduction of the plasma protein content. Thus in all the patients with edema the plasma protein values were within normal limits, the average value for total protein being 7.46 Gm. per cent (s.d. 0.42), for albumin 4.52 Gm. per cent (s.d. 0.32), and for globulin 2.94 Gm. per cent (s.d. 0.44). The average values for patients without edema were total protein 7.49 (s.d. 0.54), albumin 4.34 (s.d. 0.20), and globulin 3.15 (s.d. 0.38) Gm. per cent.

There was no significant difference between the cardiac size of the two groups. The patients with normal blood thiamine levels averaged 105 per cent of the ideal cardiac area and those with low blood thiamine 110 per cent of the estimated ideal area. No significant difference in pulse rate was observed between the two groups.

In both groups the incidence of achlorhydria was high, 35 per cent of the individuals having no free hydrochloric acid in the gastric secretion. There was no significant difference between the two groups.

An evaluation of the state of nutrition of the subjects showed that the individuals with normal thiamine values averaged 110 per cent of the estimated ideal weight and those with low thiamine concentration 100 per cent of the ideal weight.

Discussion

The symptoms which we have found associated with a low blood thiamine value are similar to those observed in patients in whom a depletion of the B complex vitamins was produced experimentally. Thus Horwitt, Liebert, Kreisler, and Wittman (6) found that muscular weakness was a frequent finding as was also slight edema and decreased acuity of perception of the vibratory fork on the lower extremities. Development of edema of both upper and lower extremities was observed by Elsom, Lewy, and Heublein (2) in experimental B complex deficiency. Keys, Henschel, Taylor, Mickelsen, and Brozek (7), however, noted such symptoms only after a prolonged period of almost complete vitamin B deprivation.

Our observations on the fluorescence of the tongue seem to indicate that thiamine is not the factor in the B complex responsible for the lingual fluorescence.

The observed difference in symptoms and signs between the groups with a low and a normal blood thiamine concentration does not necessarily indicate that such findings are specific for thiamine depletion, since, as mentioned in the introduction, multiple deficiencies may exist. Studies reported in the literature so far have dealt mainly with the effects of administration of vitamin B complex preparations on vitamin B depleted individuals. Similar studies on the clinical effects of thiamine administration in individuals with low blood thiamine levels would yield valuable information regarding the clinical manifestations of thiamine deficiency alone.

Summary

A clinical study of 68 middle-aged and old individuals, 42 of whom had blood thiamine values below 2.0 micrograms per cent and 26 of whom had values above 3.5 micrograms per cent, revealed that certain signs and symptoms were found with greater frequency in those subjects with low blood thiamine concentrations than in those with normal concentrations.

The findings which occurred with significantly greater frequency were general fatigue, weakness and heaviness of the legs, redness

TABLE 1. CORRELATION OF VARIOUS CLINICAL SYMPTOMS AND SIGNS WITH THE THIAMINE BLOOD CONCENTRATION IN 68 INDIVIDUALS

Symptoms and Signs	Blood Thiamine below 2.0 Micrograms %	Blood Thiamine above 3.5 Micrograms %	"t"* Test
	42 Patients	26 Patients	
	Per Cent	Per Cent	
General fatigue	43	8	3.5
Impaired appetite	8	8	0.0
Pain in tongue	3	0	1.0
Pain in swallowing	3	0	1.0
Weakness of legs	29	4	2.9
Heaviness of legs	21	0	3.0
Numbness of fingers	3	0	1.0
Numbness of legs	7	0	1.6
Paresthesia of feet	6	0	1.5
Burning of legs or feet	3	0	1.0
Pains in legs	15	0	2.4
Fissures in angles of mouth	2	0	0.9
Redness of tongue	40	12	2.8
Atrophy of lingual papillae	21	9	1.4
Fissures of tongue	41	4	4.3
Abnormal condition of gums	42	44	0.1
Toad skin	24	8	1.9
Pigmentation over olecranon	10	8	0.3
Pigmentation over ischial tuberosities	76	64	0.6
Abnormalities of scrotal skin	0	0	0.0
Scantiness of axillary hair	58	52	0.5
Scantiness of pubic hair	49	28	1.8
Blepharoconjunctivitis	48	16	3.0
Conjunctival thickening	56	24	2.8
Impaired sensibility of upper extremities	3	0	1.0
Impaired sensibility of lower extremities	3	0	1.0
Impaired temperature sense, upper extremities	10	0	1.9
Impaired temperature sense, lower extremities	13	0	2.2
Impaired direction sense, upper extremities	6	0	1.5
Impaired direction sense, lower extremities	6	0	1.5
Impaired vibration sense, upper extremities, f. 128	6	0	1.5
Impaired vibration sense, upper extremities, f. 256	10	0	1.9
Impaired vibration sense, upper extremities, f. 512	69	43	2.0
Impaired vibration sense, lower extremities, f. 128	24	4	2.4
Impaired vibration sense, lower extremities, f. 256	38	9	2.6
Impaired vibration sense, lower extremities, f. 512	73	83	0.9
Impaired coordination sense, upper extremities	6	0	1.5
Impaired coordination sense, lower extremities	7	0	1.6
Impaired supinator reflex	15	20	0.5
Impaired triceps reflex	18	16	0.2
Impaired biceps reflex	15	12	0.3
Impaired upper abdominal reflexes	42	46	0.3
Impaired lower abdominal reflexes	54	48	0.4
Impaired knee reflexes	14	12	0.2
Impaired ankle reflexes	52	28	2.0
Positive Babinski's sign	8	0	1.8
Positive Romberg's sign	14	24	0.9
Inability to lift extended leg	0	0	0.0
Inability to extend knee with hip flexed	0	0	0.0
Tenderness of calves	21	0	3.0
Edema of legs	61	16	4.3
Fluorescence of tongue in Wood's light	75	72	0.2
Circumference of thigh at the junction of middle and lower thirds	39.0 cm.	40.5 cm.	
Circumference of calves	29.8 cm.	31.5 cm.	

*"t" Test : $\frac{\text{Difference between averages}}{\text{Standard error of difference}}$

and fissures of the tongue, blepharoconjunctivitis, conjunctival thickening, impaired vibratory sense of the lower extremities, tenderness of the calves, and edema of the legs. The edema was not associated with any reduction in the plasma protein concentration.

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Mortality in Traumatic Abdominal Injuries in the Elderly

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IN OPPOSITION TO THE CONCEPT THAT THE OLDER PATIENT HAS LESS CHANCE FOR SURVIVAL AFTER INJURY TO THE ABDOMEN, DR. COLLINS PRESENTS DATA DERIVED FROM 388 HOSPITAL RECORDS IN SUPPORT OF HIS BELIEF THAT THE OLDER AGE GROUPS HAVE AS GOOD A CHANCE OF SURVIVAL AS THE YOUNGER.

THE increasingly large number of traumatic injuries to the abdomen and its contents constitute a group of grave importance to all physicians. In 1944 the average accident death rate for all age groups in the United States was 71.8 per 100,000 while that for persons 75 years of age and over was 559.3 (8). The National Safety Council (4) in Chicago reported that 98,000 persons were killed in accidents during 1948 and that 10,300,000 were injured at the staggering economic loss of $7,200,000,000.00. Zeman (9) stated that between the ages of 45 and 64 years one person in every thirty-one injured dies from traffic accidents and other types of trauma; whereas, one individual in thirteen over the age of 65 years dies from similar causes.

Metz, Householder, and Dangremond (7) recently presented an excellent resumé upon traumatic injuries to the abdomen. Cohn (2) contributed a comprehensive study upon this same subject. The historical aspects of penetrating wounds of the abdomen was summarized by Loria (5). Carp (1) reviewed the causes and methods of possible reduction of operative mortality in geriatric surgery in a recent valuable contribution. Martin (6) discussed the problems of the surgical risk in the elderly patient.

The question arose as to how the older patient withstood acute traumatic injuries to the abdomen and its contents. My impression, before this study was made, was that those individuals over the age of 40 years did not withstand such severe traumatic injuries and that this hypothesis would be substantiated by increased hospital mortality rates. The available records from both The Hollywood-Presbyterian Hospital and The Los Angeles County General Hospital were reviewed between the years of 1928 and 1947; a total of 388 cases consecutive unselected instances of acute traumatic injuries to the abdomen and its contents were studied.

Table 1 summarizes the important data derived from a study of the available records of The Los Angeles County General Hospital between the years of 1928 and 1947. Table 2 likewise sums up the same data derived from The Hollywood-Presbyterian Hospital for the thirteen year period between 1935 and 1947. Table 3 totals the data in tables 1 and 2 and in addition lists the principal etiologic factors responsible for these abdominal injuries.

The conclusion derived from these three tables is that for the total sum of abdominal visceral injuries there is no significant difference in mortality in patients over the age of 40 years when compared with younger patients. In some types of injury, the mortality was actually lower in those over the age of 40 years.

SUMMARY

1. From the study of 388 consecutive unselected case-histories of patients with traumatic abdominal viseral injuries derived from the available records of both The Los Angeles County General Hospital and The Hollywood-Presbyterian Hospital between the years of 1928 and 1947 it is conclusively demonstrated that there was no appreciable difference in mortality rates between patients over the age

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of 40 when compared with the rate in younger patients.

2. This study demonstrates that the old patient who receives a severe traumatic injury to the abdomen or its contents in general has just as good a chance to survive as the younger patient similarly injured.

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TABLE 1. CASES FROM THE LOS ANGELES COUNTY GENERAL HOSPITAL: 1928-1947

Principal Organ Injured†	Age in Years: 40-59 — 49 Cases: Cases	40-59 — 49 Cases: Deaths	60 and Over — 36 Cases: Cases	60 and Over — 36 Cases: Deaths	Total Number of Patients Above 40 Years — 85 Cases: Cases	Deaths by Sex	Total Deaths	Mortality Percentage of Total Cases of Type	Below 40 Years — 140 Cases: Number	Deaths	Mortality Percentages	"t" Test*	Significant Difference
	No.	No.	No.	No.	No.	No.	No.		No.	No.			
Spleen	20	M. 7 F. 0	19	M. 3 F. 3	39	M. 10 F. 3	13	33.33	63	25	40	0.4	None
Liver	11	M. 5 F. 0	6	M. 4 F. 0	17	M. 9 F. 2	11	64.71	21	21	100.0	2.9	Present
Kidney	12	M. 2 F. 0	9	M. 4 F. 0	21	M. 6 F. 0	6	28.57	42	10	21	0.7	None
Small Intestine	3	M. 0 F. 0	1	M. 1 F. 0	4	M. 1 F. 0	1	25.00	10	1	10.0	1.6	None
Miscellaneous	3	M. 2 F. 0	1	M. 1 F. 0	4	M. 3 F. 0	3	75.00	4	0	0	3.4	Present
All Abdominal Viscera	49	M. 16 F. 0	36	M. 13 F. 0	85	M. 29 F. 5	34	39.99	140	57	40.71	0.1	None

NOTE: † Incomplete Statistics.

* —"t" Test: $\frac{\text{Difference between averages}}{\text{Standard area of difference}}$

M.—Male.

F. —Female.

TABLE 2. CASES FROM THE HOLLYWOOD-PRESBYTERIAN HOSPITAL: 1935-1947

Principal Organ Injured†	Age in Years												
	40-59		60 and Over		Total Number of Patients Above 40 Years				Below 40 Years				
	51 Cases		26 Cases		77 Cases				86 Cases				
	Cases	Deaths	Cases	Deaths	Cases	Deaths by Sex	Total Deaths	Mortality Percentage of Total Cases of Type	Number	Deaths	Mortality Percentages	"t" Test*	Significant Difference
	No.	No.	No.	No.	No.	No.	No.		No.	No.			
Spleen	6	M. 1 F. 0	5	M. 0 F. 1	11	M. 1 F. 1	2	18.18	11	2	18	0.0	None
Liver	8	M. 2 F. 0	2	M. 0 F. 0	10	M. 2 F. 0	2	20.00	15	4	26.6	0.4	None
Kidney	9	M. 1 F. 0	2	M. 0 F. 0	11	M. 1 F. 0	1	9.09	20	3	15	0.5	None
Small Intestine	15	M. 1 F. 3	10	M. 2 F. 3	25	M. 3 F. 6	9	36.00	12	4	33	0.2	None
Miscellaneous	13	M. 1 F. 1	7	M. 2 F. 0	20	M. 3 F. 1	4	20.00	28	10	36	1.2	None
All Abdominal Viscera	51	M. 6 F. 4	26	M. 5 F. 3	77	M. 11 F. 7	18	23.4	86	23	26.7	0.6	None

NOTE: † Incomplete Statistics.

* —"t" Test: $\frac{\text{Difference between averages}}{\text{Standard area of difference}}$

M.—Male.
F. —Female.

TABLE 3. CAUSE OF INJURY

Cause of Injury†	Total Cases from Both the Los Angeles County General and Hollywood-Presbyterian Hospitals: 1928-1947 — Data: Spleen	Liver	Kidney, (Both)	Small Intestine	Miscellaneous	Total Number of Cases	Percentage of All 388 Cases	Total Number of Deaths	Total Mortality Percentage	Cases Between 40-59 Years	Cases 60 or More Years	Total Cases Over 40 Years	Total Deaths Over 40 Years	Mortality Percentage in Cases Over 40 Years	Significantly Increased Mortality in Cases Over 40 Years
Auto versus—															
Pedestrian	27	27	22	12	13	101	26.02	39	29.54	20	22	42	16	32.0	None
Auto vs. Auto	13	7	11	14	2	47	12.12	16	12.12	16	7	23	5	10.0	None
Other Auto Accidents	16	15	10	5	13	59	15.22	24	18.18	18	5	23	6	12.0	None
Falls	13	1	14	3	14	45	11.61	11	8.33	12	9	21	7	14.0	Present
Kicks or Blows	8	2	6	7	8	31	7.97	6	4.56	7	5	12	3	6.0	None
Gunshot Wounds	7	1	1	3	0	12	3.09	4	3.03	3	2	5	2	4.0	None
Stab Wounds	4	1	2	1	1	9	2.32	2	1.51	2	2	4	1	2.0	None
Kicks by Animals	3	2	3	2	0	10	2.58	2	1.51	4	1	5	1	2.0	None
Athletic Injuries	1	0	7	1	0	9	2.32	1	0.76	3	0	3	0	0.0	None
Street Car or Train	19	6	10	3	2	40	10.32	18	13.63	10	8	18	6	12.0	None
Bicycle	2	0	4	0	0	6	1.54	2	1.51	1	0	1	1	2.0	None
Motorcycle	11	1	4	0	0	15	3.86	5	3.79	3	0	3	1	2.0	None
Miscellaneous	0	0	0	0	4	4	1.03	2	1.51	1	1	2	1	2.0	None
Totals	124	63	94	51	56	388	100.02	132	99.98	100	62	162	50	100.0	

NOTE: † Incomplete Statistics.

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A Pasteboard Leg Prosthesis for Elderly Patients

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IN THE REHABILITATION OF OLD PEOPLE WITH AN AMPUTATED LEG THE PROVISION OF A PROSTHESIS IS FREQUENTLY A MAJOR PROBLEM BECAUSE OF THE WEIGHT OF THE USUAL TYPE OF ARTIFICIAL LEG AND ITS EXPENSE. IN THIS PAPER DR. RAAGAARD DESCRIBES A SIMPLE PASTEBOARD PROSTHESIS WHICH HAS BEEN USED SUCCESSFULLY IN EUROPEAN COUNTRIES SINCE THE FIRST WORLD WAR.

DURING the first world war Dr. J. Svindt (1), Denmark, constructed a temporary pasteboard prosthesis for patients who had had their leg amputated above the knee. This inexpensive prosthesis subsequently achieved great popularity in France, England, and Italy and in Denmark is still extensively used as a valuable and inexpensive therapeutic measure in the preliminary treatment of above the knee amputees.

In my experience, however, difficulties are sometimes encountered from use of prostheses constructed in the ordinary (somewhat too simple) way, and the results have not always been completely satisfactory. For this reason I have modified the construction of the prosthesis and thereby in my opinion achieved essential advantages.

One of the most important features in the construction of the prosthesis is that it should be fitted to the stump when this is held in the natural position of rest, which corresponds to a few degrees flexion in the hip. If this is accomplished the ischial tuberosity will come into contact with the upper rim of the prosthesis and afford an effective support. If, on the other hand, the stump is forced into full extension in the hip joint, the upper rim of the prosthesis will be inclined to press on regions less satisfactory for support (e.g., the perineum).

The Svindt prosthesis was originally designed as a temporary inexpensive lower extremity prosthesis for war amputees. For old patients, however, the prosthesis often suffices as a *permanent* prosthesis. It has the advantage of being less heavy than the usual artificial limb and the price of construction is less than one-sixth that of an ordinary leather prosthesis. Its great value is that it gives many indigent old persons a chance of moving around instead of being confined to a chair or to the bed. The model is also applicable to below knee amputees.

The construction of the prosthesis is so comparatively easy that most physicians will be able to make the pasteboard leg themselves. In any case it can be readily made by a craftsman.

DIRECTIONS FOR CONSTRUCTION

The pattern of the prosthesis is outlined on a piece of pasteboard 3.3 to 4 mm. thick (see fig. 1).

The line AEB is the circumference of the stump measured just below the ischial tuberosity. The upper border is drawn as shown in the figure with a recess for the perineum and projections for the ischial tuberosity and the trochanter.

EF: the length of the normal leg (measured from the ischial tuberosity) —10 cm. (the length of the wooden stump).

CD: about half of AB.

AG (and BH) the length of the stump (measured from the ischial tuberosity) + 5 cm.

The angles x are about 5°. If the stump is more then usually flexed in the hip joint the angles may be made a little greater, but care should be taken that the circumference of the limb will not be so large that the prosthesis cannot fit inside the clothes.

GI (and HI) are drawn at right angles to AG (and BH).

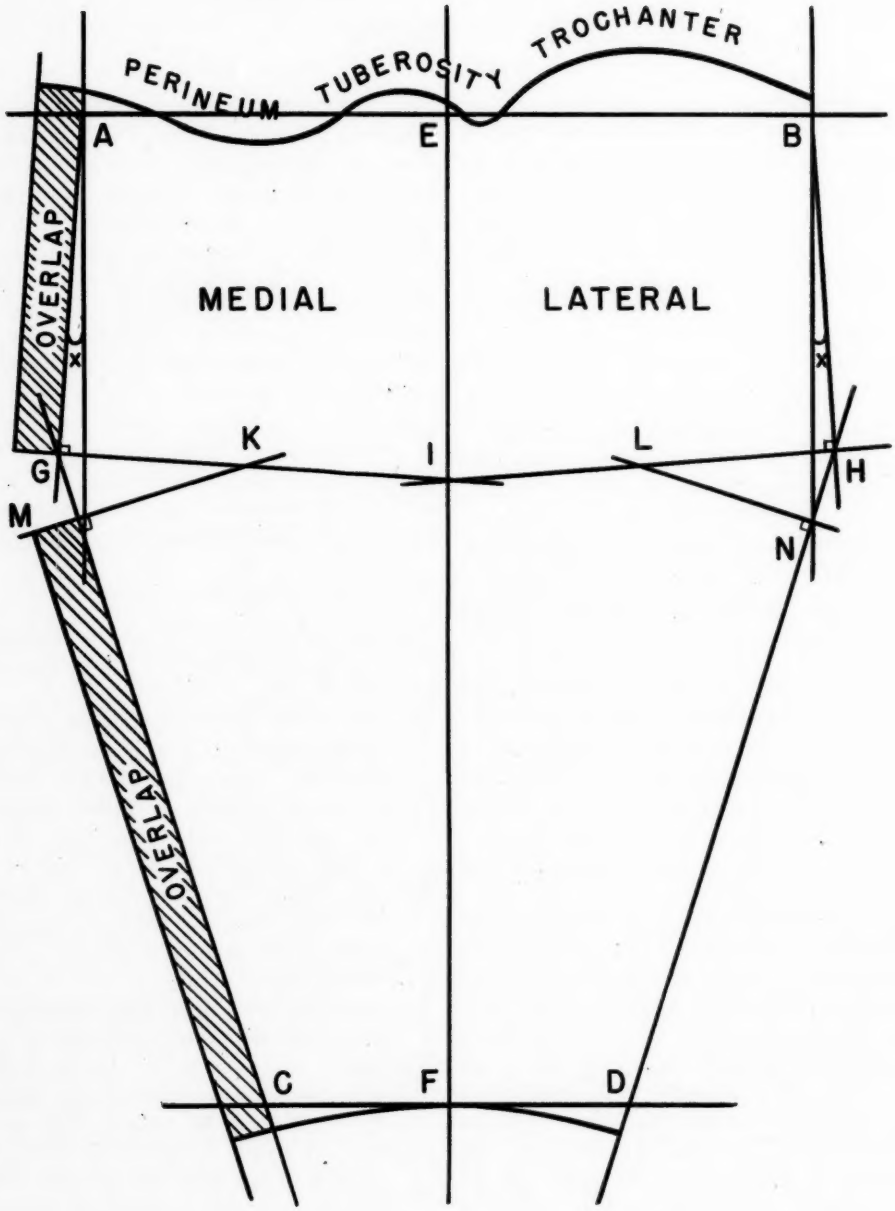

FIG. 1. Diagram for construction of pasteboard leg prosthesis.

Dr. Raagaard received his M.D. degree from the University of Copenhagen in 1932 and his authorization as a specialist in surgery in 1939. Since 1946 he has been senior assistant at Faaborg Hospital in Denmark. His chief field of interest is in postoperative complications.

K (and L): the midpoints of GI (and HI).
MK (and NL): drawn at right angles to CG (and HD) through K (and L).

After the pattern is drawn the pasteboard is carved with a knife (including the angles GKM and HLN).

The pasteboard is then soaked in water, carefully bent (not infracted), and stitched in front along the overlap.

The upper rim of the prosthesis is bent a little outward. The important projection for the ischial tuberosity is further bent somewhat downwards and is stitched over a roll of paper. In addition the pasteboard at

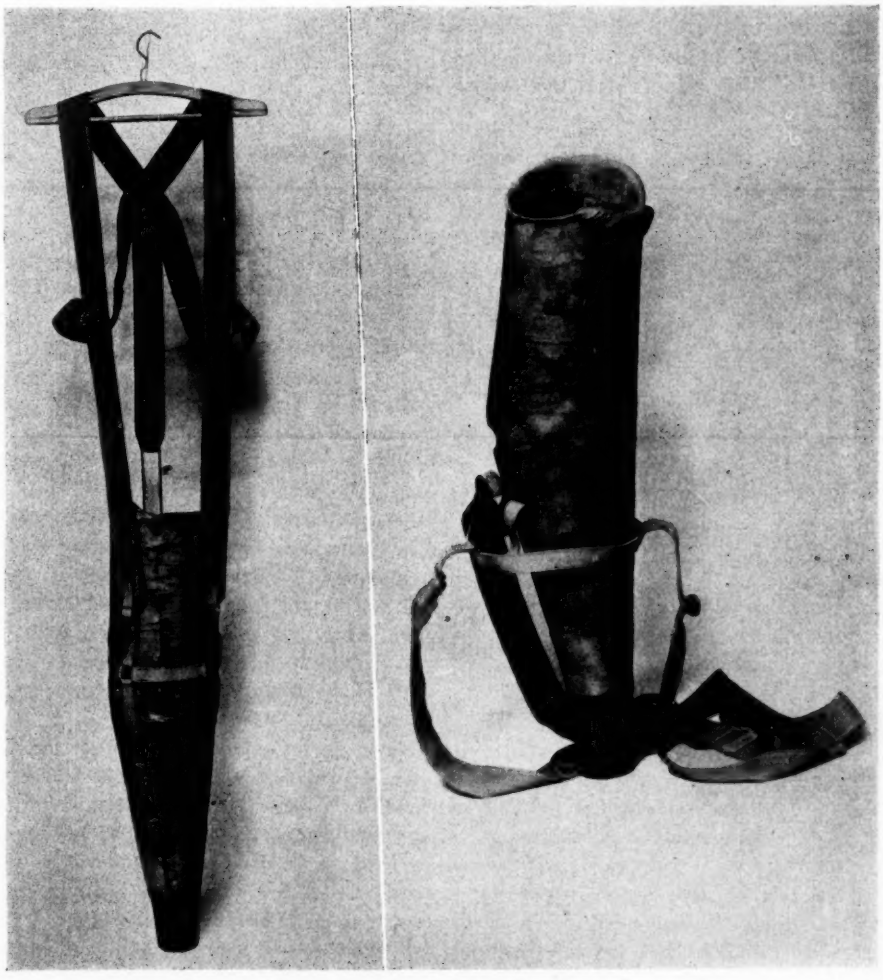

FIG. 2. Photograph of pasteboard prosthesis with shoulder support.

this place (and only at this place) is pushed a little into the lumen of the prosthesis. While still wet the fit of the prosthesis is tested on the patient, special care being taken to ensure that the upper rim fits closely.

When the pasteboard is dry the prosthesis is covered with a starch bandage. When this has dried the surface is shellacked twice and afterwards treated with cellulose varnish. An air hole is then drilled into the lower part of the limb. Finally an 8 to 10 cm. rubber tipped wooden stump is attached to the end of the prosthesis and a layer of fine leather stitched to the surface of the support for the ischial tuberosity. It is convenient to supply the prosthesis with a shoulder support (see fig. 2).

Summary

A simple prosthesis for leg amputees, made of pasteboard, is described. The prosthesis is light and both for this reason and because of its inexpensiveness is particularly suited for use by gerontologic clientèle. It can be made by the physician himself or by a craftsman.

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The Personal Adjustment of Recipients of Old Age Assistance

ETHEL SHANAS

FROM A DETAILED STUDY OF A GROUP OF 127 MEN AND 261 WOMEN AGED 65 AND OVER, DR. SHANAS LISTS FACTORS WHICH AFFECT ADJUSTMENT IN A LOW INCOME GROUP. IT WAS FOUND THAT DEFINITE PLANS AND HOPES ABOUT THE FUTURE WERE OF SPECIAL SIGNIFICANCE FOR GOOD ADJUSTMENT. THE MEAN ADJUSTMENT SCORE OF THIS INDIGENT GROUP WAS LOW, ONLY 29.2. THIS PAPER WAS GIVEN AT THE SECOND ANNUAL SCIENTIFIC MEETING OF THE GERONTOLOGICAL SOCIETY IN CHICAGO, NOVEMBER 5-6, 1949.

THIS study, a project of the Committee for the Study of Later Maturity at the University of Chicago, is an investigation of the factors associated with the personal adjustment of recipients of Old Age Assistance benefits living within a square-mile area in Woodlawn, a rooming house and apartment house district in Chicago's South Side. Personal adjustment, as the term is used in this research, is defined as "the adaptive changes in behavior in the individual in response to new situations," and is measured by the individual's score on the Your Attitudes section of the Your Activities and Attitudes schedule. This latter schedule, designed especially for use with older persons, was developed and standardized by E. W. Burgess, R. S. Cavan, and R. J. Havighurst. A full report on the schedule and its uses is given in *Personal Adjustment in Old Age* (1).

The study group in this research included 127 men and 261 women, all of whom were over 65 years of age. Forty-three per cent of the men in this study (55) and 48 per cent of the women (126) were between the ages of 65 and 74. Of the total study group 47 per cent were under 75, 31 per cent were between 75 and 79, and 22 per cent were 80 years of age or older. The group was largely native-white. Only 36 of the men and 57 of the women, roughly 24 per cent of each sex, were foreign-born.

A careful analysis was made of the past history of the members of the study group, their conception of their present physical condition and their living arrangements, and these items were related to their adjustment scores. Four categories of adjustment were used in making these analyses. Numerically the categories correspond to the following scores on the Your Attitudes section of Your Activities and Attitudes.

TABLE 1. NUMBER OF CASES IN EACH ADJUSTMENT CATEGORY AND RANGE OF ATTITUDE SCORES IN EACH CATEGORY

Adjustment Category	Attitude Score	Number of Cases
1	37-54	119
2	31-36	104
3	19-30	117
4	0-18	31

Individuals in these four categories may be described as having (1) good adjustment, (2) average adjustment, (3) minor adjustment problems, and (4) major adjustment problems.

An analysis of the present life situation of the study group indicates:

1. Women at every age receive higher modal adjustment scores than men.

2. Foreign-born women have lower modal adjustment scores than do native-born women.

3. Men who are married and living with their wives have higher modal adjustment scores than other men. Women who are married and living with their husbands, however, do not have higher modal adjustment scores

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than other women who are widowed, separated, or divorced.

4. In terms of living arrangements, both men and women who are living with spouses have higher modal adjustment scores than individuals who live alone.

5. For both men and women, a higher proportion of the best-adjusted than of other groups report that their present living arrangements are the result of choice rather than necessity.

6. Men in the better adjusted categories report more friends than do women in these categories.

7. Women in the best-adjusted categories have a greater number of intimate friends than either men or women in other categories.

8. The modal group of both men and women in the better adjustment groups report their health as "fair." In the group with poor adjustment, there is a tendency for persons to report their health as "poor."

9. For both men and women, a higher proportion of the poorer adjusted than of other adjustment groups report that they have four or more different physical problems.

10. For both men and women, the greater the number of leisure-time activities, the higher the adjustment category.

11. For both men and women, a higher proportion of the better adjusted than of the poorly adjusted report that they have hobbies.

12. For both men and women, the proportion of individuals who never read is inversely related to adjustment.

13. Better adjusted men and women participate more in clubs and organizations than do individuals with lower adjustment scores.

14. Regular church attendance and regular Bible reading are reported most often by the best-adjusted individuals.

15. A feeling of economic security is related to good adjustment.

16. Individuals who report that life has treated them badly have lower adjustment scores than do others.

A review of the past history of the study group shows:

1. For both men and women, those individuals who believe that their health has declined markedly in the past ten years have lower adjustment scores than others.

2. For both men and women, those individuals who see their friends less often than they did ten years ago have lower adjustment scores.

3. For men, past high occupational status is related to good adjustment.

4. For both men and women, downward social mobility over the past ten years is inversely related to good adjustment.

5. For persons who have been married, a high degree of happiness in their marriage is positively associated with good adjustment.

6. The proportion of individuals who feel that they never had an unhappy period in their lives declines from the best-adjusted to the poorest-adjusted group.

The data also allowed us to make some investigation of the role of the future in old age. According to certain psychiatrists, hope is the guiding force in integration through life. If one accepts this position, hope about the future should be important in adjustment in old age. The findings indicate that a higher proportion of well adjusted than of poorly adjusted individuals have definite plans and hopes about the future. Further, a higher proportion of well adjusted individuals than of poorly ad-

justed individuals are sure of a life after death. One may say for these people that even if they are among those who envisage a blank earthly future they still hope things will be better in a future world.

One important question which gave some conception of how these old people saw themselves was: "If you could have three wishes what would they be?" As far as can be judged from these data, irrespective of adjustment category, all the old people in the study wanted much the same sort of things from life—to have good health and to be secure financially. Almost no one wished for the abstraction called happiness.

On the basis of a detailed investigation of the various hypotheses developed in this preliminary analysis, 31 items which discriminated between varying degrees of adjustment on the part of the subject were selected from the questions in Your Activities and Attitudes schedule.

The items and the replies indicative of good adjustment are listed in table 2. These 31 factors, of course, may be further classified in accordance with the areas of life with which they are concerned: family relationships, friendships, health, leisure-time activities, religion, financial security, and self conception. Attention in future research will be given to the reduction of these items by their combina-

TABLE 2. FACTORS FAVORABLE TO ADJUSTMENT

Factor[1]	Reply Favorable to Good Adjustment
The Present	
1. Nativity	Native-white
2. Marital status	Married
3. Family relationships	High score
4. Living arrangements (With whom)	Living with spouse
5. Living arrangements (Choice or necessity)	"Choice"
6. Friends	More than 25
7. Intimate friends	More than 10
8. Health	Fair or better
9. Physical problems	Less than 4
10. Health score	High
11. Leisure-time activities	Six or more
12. Hobbies	One or more
13. Reading	An hour or more daily
14. Organizations	Belong to one or more
15. Attendance at meetings	At least once a month
16. Activity score[2]	Twenty or more
17. Church attendance	Once a week or more
18. Read Bible	Regularly
19. Listen to radio church service	Once a week or more
20. Financial situation	"Enough to get along on" or "Comfortable"
21. Feeling of permanent economic security	Yes
22. Age-group	Thinks himself middle-aged
23. Comparison with siblings	Favorable
24. Discriminated against in life	No
The Past	
25. Health compared with 10 years ago	No marked decline
26. Friends compared with 10 years ago	No marked decline
27. Social status compared with 10 years ago	The same or upward
28. Evaluation of marriage	Happy
29. Unhappy periods in life	None
The Future	
30. Future plans	Yes
31. Belief in after-life	Sure

[1] These 31 items were discriminating for either sex alone or for both sexes together. In selecting these items hypotheses which were demonstrated valid for one sex only and clearly invalid for the other sex were disregarded. Those hypotheses which were valid for one sex and questionable for another were included.

[2] Based on score values assigned to the answers on 19 items in the questionnaire.

tion into a smaller number of factors relating to these areas.

The proportions making favorable replies on each of these items in each adjustment category of the total study group and of the study group sub-divided by sex decreased from the best-adjusted to the poorest-adjusted groups in a pattern whose chance occurrence is extremely unlikely.

We cannot tell from our data, however, whether these 31 items and the particular responses selected as indicative of good adjustment would be discriminating for other population groups than the indigent. They might not be. It may be mentioned that the mean adjustment score of our group was 29.2. This is far lower than the mean adjustment score for other population groups, such as ministers (38.1), Young Men's Christian Association secretaries (43.6), and school-teachers (36.9), whose adjustment has been rated through the use of the same instrument.

In conclusion an outline of the technical problems involved in questionnaire studies of older people is pertinent. Questionnaires are being used increasingly in this field and their employment has many advantages. Schedules may be distributed to large numbers of persons with a minimum of effort, and thus data pertinent to the problem under investigation may be collected rapidly and simply. Questionnaire techniques, however, must be carefully designed and must be evaluated with due regard to the errors which may be introduced into the data by the limitations of the study method.

An ideal questionnaire study of older people should be so designed that the following sources of bias may be controlled or evaluated:

1. reliability and validity of question response
2. technique of approach
3. interviewer variability
4. sampling

Although the primary interest in the present research was to develop the relationship between the adjustment scores and the replies on the Activities and Attitudes schedule, it was possible to evaluate the study findings in terms of some of the previously mentioned sources of bias. The techniques used in this evaluation will not be reviewed here other than to say that the findings indicate that the validity of the answers made on the questionnaire was good; that is, the old people seemed to tell us the truth for those items in the questionnaire which could be checked against their case records.

Further, when the participants in this research, 388 persons, were compared with non-participants in this research, some significant differences were found. The participant group, compared to the 369 Old Age Assistance recipients in the same area who refused to complete schedules, was found to include a greater than expected number of persons under 75 years of age, a greater than expected number of persons living alone, an excess of women with a large number of physical problems, and fewer persons whose adjustment is average or better than might be expected by chance. It has previously been demonstrated that while age and living with friends and relatives are not significantly related to adjustment, the number of reported physical problems is inversely related to adjustment. Therefore the finding that our respondent group contains an excess of persons with a greater number of reported physical difficulties than might be expected by chance is in accord with the finding that the study group contains a fewer number of cases with good adjustment than one might expect.

Despite the bias of the study group the patterning of the items related to good adjustment may still be generally valid. Some of the further research using the Activities and Attitudes questionnaire should be devoted to testing whether this pattern of items has validity only for this group of the indigent or for other groups in the older population.

Summary

In a study of 388 men and women in a low income group, 31 factors in the Activities and Attitudes schedule were found to be associated

with good adjustment in old age. These factors concern the areas of family relationships, friendships, health, leisure-time activities, religion, financial security, and self conception.

A further analysis of these 388 cases indicates that they represent a biased sample and the direction of the bias has been indicated.

The conclusions which have been drawn from this comparison of the 388 Old Age Assistance recipients in this study with the 369 nonparticipants living in the study area have a general application. It has been demonstrated that even in a comparatively homogeneous group, geographically compact, economically similar, the uncontrolled use of survey methods results in a biased group of cases. What this implies, of course, is that questionnaire studies of sociologic and psychologic topics in old age should be concerned with the methods of case selection as well as with the securing of numbers of cases. A study designed to control as many biasing factors as possible would give valid generalizations which cannot be made from data, however extensive, collected without some control over the possible source of biasing errors.

This investigation was made possible through the cooperation of the Public Assistance Division of the Cook County, Illinois, Bureau of Public Welfare.

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Attitudes of Superior Groups Towards Retirement and Old Age

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G. STANLEY HALL CIRCULATED A QUESTIONNAIRE ON ATTITUDES TOWARDS OLD AGE IN 1922. DR. CHANDLER ADDED QUESTIONS ON RETIREMENT AND LEISURE INTERESTS AND CIRULATED THE EXPANDED QUESTIONNAIRE IN 1947-1948. THE RESPONSES TO BOTH QUESTIONNAIRES ARE COMPARED AND DISCUSSED.

BEFORE his retirement in 1920, G. Stanley Hall (1846-1924) was professor of psychology and president of Clark University. In 1923 he published *Senescence,* a volume of 518 pages (2). Chapter VII of this volume reports the results of a questionnaire which he had circulated, presumably in 1922. His description of the group to which he sent it is far from precise. He says that he "selected a few score of names of mostly eminent and some very distinguished old people, both acquaintances and strangers . . . ."(p. 321). He adds that some who replied were "of national and international reputation." All of them were "cultivated Americans" and most were "Anglo-Saxons." To these he later "added data from less than a score of others of the same class." Later (p. 333) he mentions that one-third were men of science.

In 1947 it occurred to me that it would be of interest to compare the responses of a present-day group with those obtained by Hall twenty-five years earlier and to obtain responses on retirement as well as old age. Accordingly a questionnaire was prepared and circulated during 1947 and 1948. This included Hall's fourteen questions and fifteen new questions.

Since Hall's report contains few numerical statements, and since both his sample and mine are small, there will be no attempt at elaborate statistics.

PERSONS CIRCULARIZED AND PERSONS RESPONDING TO THE 1947-1948 QUESTIONNAIRE:

1. A Columbus group consisting of:

a. about 100 members of the Torch Club, an organization of professional men, about one half of whom are college professors and very few of whom are under 40;

b. twenty men in a discussion club of Ohio State University professors;

c. forty emeritus professors of Ohio State University. Overlapping reduces the total number in the Columbus group to about 150, more than 40 per cent of whom are listed in *Who's Who in America.* Sixty-four responded.

2. Two hundred persons in their forties listed in *Who's Who* whose names appear on arbitrarily chosen pages. Thirty-three responded.

3. Two hundred persons in their seventies whose names appear on the same pages. Thirty-three responded.

Since these three groups included only half a dozen women they may be considered masculine groups.

4. One hundred Vassar alumnae of the class of 1922 and 100 of the class of 1923; these are presumed to be in their forties. Nine responded.

5. Eighty Vassar alumnae of the class of 1897, 80 from the class of 1898, and 40 from slightly earlier classes; these are presumed to be in their seventies. Thirty-four responded, of whom 15 have been mainly home-makers and 19 mainly in professional life.

Total number circularized, 950; total responding, 173.

The present group corresponds fairly well to Hall's vaguely defined group. It is not confined to geniuses or millionaries but it represents a segment of the population of presumably superior intelligence, education, personal adjustment, and socio-economic status.

The present questionnaire is divided into three parts. Part A was mainly for persons not retired; Part B was equally for retired and unretired persons; Part C was mainly for retired or aged persons. Respondents were free to choose the questions that applied to them. Hall's questions were included in C.

Dr. Chandler received his B.A. degree from Dartmouth College in 1908 and his Ph.D. degree from Harvard in 1913; he also studied at Marburg and Goettingen. He was assistant in philosophy at Harvard from 1912 to 1913, instructor from 1913 to 1914, assistant professor of philosophy at Ohio State University from 1914 to 1925, professor since 1925, and visiting associate professor of philosophy, New York University, 1924-1925.

which was answered by 97 persons, including the two 70 year groups and 20 of the Columbus group.

Comparison of Responses in 1922 and in 1947-1948

C.1. *How and at what age did you first realize the approach of old age?*

1922: Hall reports:

> This realization not infrequently begins in the forties and increases thereafter, often intensively with the beginning of each new decade. The first sign of baldness, the first touch of fatigue at stated tasks, lapse of memory for names, waning potency in men; and the first gray hairs, wrinkles, fading of complexion, and change of figure, etc., in women are often specified in our returns (p. 322).

1947-1948: The date of the first realization of old age ranges from the forties to the seventies, and many in their seventies and eighties declare they have never realized it. Indications most frequently mentioned are some break in health or new susceptibility to fatigue. One woman reports, "I found myself bringing the second foot to the same stair as the first and said to myself, 'This is old age!'" Many emphasize the gradualness of the change, which prevents dating a first realization. Waning potency is not mentioned.

C.2. *To what do you ascribe your long life?*

1922: "Good heredity is much more often specified than anything else." Other factors mentioned are good and temperate habits, avoidance of worry, care of health due to early weakness, strenuous physical activity in youth, tapering off of activities in later years.

1947-1948: All groups join with Hall's respondents in mentioning heredity more frequently than any other factor. "Moderation in all things" is often joined with it. In contrast to the earlier group a considerable number mention periodic medical examinations. Occasional mention is made of keeping busy, avoiding strain and worry, the care and companionship of spouse or relatives. One man aged 82 writes, "I start every morning with a resolve 'to beat my own record.'"

C.4. *How do you keep well, that is, what do you find especially good or bad in diet, regimen, interests, and personal hygiene generally?*

1922: Hall found "the utmost diversity" in responses. Credit was given to many drugs or the avoidance of drugs, to wine, to abstinence from tea, coffee, and tobacco, or moderation in these; to naps and to early retiring (p. 326). Hall says:

> Most ascribe much virtue to daily, and particularly to cold baths, shower, spray, etc., . . . Most stress the importance of exercise, varied and out-of-doors, particularly walking. . . . Most had given considerable attention to diet and had drawn up lists of things good or bad for them (p. 327).

1947-1948: The most usual emphasis is upon common sense and avoidance of extremes. Respondents, especially women, often mention care in eating but do not give definite diet lists. Members of this group say nothing about baths; they evidently take bathing for granted, and are not inclined, like the earlier group, to "ascribe much virtue" to it. A considerable number mention medical examinations.

C.5. *Are you troubled with regrets for things done or not done by or for you?*

1922: Hall found "no vestige of tragic remorse of either the old classic or theological kind, although only one disclaimed every trace of regret for anything in the past."

Themes of regret regarding their own conduct included waste of time and energy, waste of money, wrong choice of calling, mistaken marriage, too little generosity, too little attention to family, too little achievement.

> Other old people have a dull and sometimes corroding sense of sexual errors in their past that may have impaired the quality of all their family relations and even the constitution of their children (p. 329).

Regrets regarding acts of others include "their training as children, the effects of which it had taken years to overcome," lack of sex instruction, "too strict moral and religious regimen," and unjust treatment.

1947-1948: In contrast to the earlier group, 40 deny all regret. Admissions of regret are usually vague. No mention is made of "sexual errors." There are scarcely any complaints regarding acts of others.

C.6. *What temptations do you feel, old or new?*

1922: Hall says, "more of my respondents failed to answer this question than any other and most answers were brief," and adds that "resistances to anything like confessionalism increase with age." Specific temptations reported were:

> to overeat, to underexercise, to take life too easy or to be too tardy to throw off responsibilities, to read or think too much, to be censorious and intolerant, to resent the cocky infallibility of the young, the excessive urge to speed up, the danger of getting cranky, of brooding; and a few speak vaguely of temptations of the flesh. Nearly all say they are less prone to yield to temptations than in middle life.

1947-1948: In contrast to the earlier group, 40 deny all temptation. The temptations most frequently mentioned are the opposite extremes of laziness and overexertion. Next come overeating and loss of temper.

C.7. *What duties do you feel that you still owe either to those about you or to the world?*

1922: Duties recognized include provision for families and friends, to avoid being useless, to give advice and admonition.

> Some who have been lifelong slaves to duty resolve that they will now emancipate themselves and live henceforth according to their own pleasure. . . . [some scientists] have unfinished studies, which they feel it is their supreme duty to complete before their powers abate.

Hall's most general conclusion is that—

> The old are prone to develop, if they have not had it before, a kind of educational instinct in the larger sense of the word; they wish to admonish and to exhort. . . .

1947-1948: Responses on the whole are similar to those of the earlier group. The major emphasis is upon being useful in various ways to one's family or to society.

C.8. *Is your interest in public, community, or in far future or past things, as compared with interest in persons and things right about you, greater or less than formerly?*

1922: Hall saw two tendencies, one toward broader interests, the other toward narrowing of interest "to the here and now of each day, and if health is impaired, the chief concern may be personal well- or ill-being. . . ." (p. 335).

1947-1948: The opposing tendencies mentioned by Hall reappear, but the most frequent response is "no change".

C.9. *In what do you take your greatest pleasure?*

1922: A few reported no change, but most had found new pleasures or a greater opportunity for old ones. Reading was oftenest mentioned. (In reading, many had turned from novels to biography and history or to the classics of literature.) "Nearly all our correspondents seek and find solace in themselves more than before." Next came nature and below that, society (p. 338).

1947-1948: As before, reading is the item most often mentioned, and similar changes of taste are noted. Human relations are more favored than nature or solitude. Women especially emphasize family ties and friends.

C.12. *Do you enjoy the society of children, young people, adults, or those near your own age more or less than formerly?*

1922: Hall claims to find a tendency for the gregarious instinct to wane and for the old to prefer to associate with people in middle life.

> A few of the very old like children, but often with reservations or at a distance, and are prone

> to be annoyed by their noise or too great familiarity. . . .

He also notes an increased concern for pets. He finds women more likely than men to be interested in children and the young.

1947-1948: By far the commonest report is "no change," but specific changes noted are too varied to conform to the trends mentioned by Hall. No one mentions pets.

C.13. *Would you live your life over again?*

1922: "All answered this question but three could not decide." One would gladly relive every bit of it without change; another "recoiled with horror from the thought." Some would relive parts of life. Some wished to make corrections.

1947-1948: 42 say yes; 15, yes with conditions; 10 say no. A clergyman of Texan origin says, "I sure would twice over, every day is zippier." One man says, "If I could go back—yes. If it were in the future—scared to death."

C.14. *Did you experience an "Indian summer" of revived energy before the winter of age set in?*

1922: Only five responses were affirmative.

1947-1948: 49 say no; 5, yes; a few are doubtful. One woman speaks of being especially active in the first year of her retirement. Some deride the notion of a winter of old age, or insist that they do not feel old.

C.15. *Do you rely more or less on doctors or find that you must study yourself and be your own doctor?*

1922: Hall reports—

> . . . a general consensus to the effect that doctors were resorted to only in emergencies of illness, accident, or perhaps surgery. . . . Only a few followed the practice of having a look-over at intervals as a prophylactic.

Many showed distrust of all or nearly all doctors (p. 351).

1947-1948: Most respondents of both sexes show a favorable attitude toward doctors. A larger minority of women stress self-study. A considerable minority report regular medical check-ups.

C.16. *Do you get more or less from the clergy and the church than formerly?*

1922: All of Hall's respondents denied getting more from the clergy and the church than formerly, and many showed an antagonism toward them (p. 353).

1947-1948: More than one-third report no change; some of these indicate a continued favorable attitude, others, a continued unfavorable attitude, and others are silent on this point. A smaller number report lessened interest, and a still smaller number, increased interest. Less hostility toward church and clergy was shown by the later group.

C.17. *Do you think or worry about dying or the hereafter more or less than formerly?*

1922: Hall reports:

> All my respondents but four answered the question, but only four of them (three women) found anything like the orthodox religious consolation afforded by the hope of immortality. . . . Most were agnostic. . . . Most had ceased to worry about death, a few professed never to think of it (pp. 354-355). . . .

1947-1948: A great majority deny any increased worry. One interesting response was, "Not a damn bit!! House in order and ready —when!" Another, "Worry is atheistic." As in the former group, very few expressed an orthodox conception of immortality.

Questions C3, C10, and C11 are reserved for discussion in the following section, since they were not a part of Hall's questionnaire.

Responses to Questions Added in 1947

Questions in Section A of the questionnaire were intended for people in their forties or others who have not yet retired.

A.1. a. *Shall you be required to retire at a fixed age or age-range? If so, at what age or age-range? b. Do you plan to retire voluntarily at a fixed age? If so, at what age? c. Do you plan to retire when certain conditions are fulfilled? If so, what are they? d. Do you plan to taper off your activities without retiring from your business or profession? e. Do you plan to continue full time profes-*

sional or business activity as long as health permits?

About one-fourth of the men declare they will never retire unless forced by ill health. The rest expect to retire between 60 and 70, except one who plans to retire before 60 and one after 70. Of the few professional women reporting, two expect to retire between 65 and 70; two, who are writers, expect to continue writing as long as health permits. Few respondents plan to retire when fixed conditions are fulfilled or to taper off without retiring.

A.4. Where do you plan to live after retirement? What are the reasons for your choice?

About one-third of the respondents plan to remain in their present homes. Reasons given are the presence of family and friends, cultural opportunities and the comforts of home. Another third plan to move to various states or to the country. Reasons given are climate, friends, cultural opportunities, and the peacefulness of country life. The remaining third are uncertain, omit the question, or will not retire.

A.5. With what feelings do you look forward to the later years of life:—dread, resignation, interest, hope, or what? What special aspects of that period evoke these feelings?

Persons in their forties, or others not yet retired, report interest, hope, or both more often than any other feelings. Fairly frequent is the desire for leisure, a slower pace, and freedom to pursue chosen activities or hobbies. Also fairly frequent is the dread of loss of relatives or friends and impairment of health. Some report resignation. Some wish to be spared any lingering illness, or being unproductive or a burden to others. Answers by persons past seventy show a general resemblance to those reported above.

A.7. What are the chief problems, troubles, or temptations that you foresee in your retirement? How do you expect to handle them?

The problems and troubles oftenest mentioned are ill health, too little money, idleness, boredom, loneliness. The temptation oftenest mentioned is laziness. A few declare they expect no problems, troubles, or temptations. Not many answer the question about how they will handle the situation, and the answers are various and often vague.

The questions in section B were for all respondents, regardless of age or retirement.

B.2. What is your opinion concerning systems of compulsory retirement?

Those who answered the question were 104 in favor of such systems (though often with some reservation) to 19 against.

B.3. What suggestions would you offer to others regarding preparation for retirement—physical, mental, financial, or other preparations?

There are few specific suggestions on the physical side; these include moderation, adaptation of exercise to age, and reliance on a good physician. On the financial side the most frequent suggestions are annuities or systematic savings. Suggestions as to mental preparation are most varied. They include maintaining and extending interests and hobbies, tapering off responsibilities, and a consistent philosophy.

Rejection of retirement is expressed by one who says, "Never prepare for it. Keep going." A man in his forties, listed in *Who's Who*, writes: "Work hard enough and play hard enough and take enough chances so that you won't live to an advanced age."

B.4. What changes, if any, do you notice in your taste in reading?

The most frequent report is "no change." A majority of the rest report changes away from light fiction toward more serious informative and reflective reading (history, biography, world issues, science, philosophy) or toward the literary classics. Only 7 report turning to lighter reading.

B.5. Do you find yourself increasingly irritated by ideas or attitudes of other people, in private contacts or in public life? What ideas or attitudes?

Of those who reply, 23 record increased ir-

ritation, 61 deny that they are more irritated, and 26 more declare positively that they are less irritated or more tolerant. Others omit the question or report mixed reactions. Sources or irritation include self-centered, careless or demanding types of people, political, social and economic views.

Section C is mainly for persons retired or in later years. Among the questions were:

C.3. a. At what age did you retire? b. What conditions determined the date of retirement? c. Have you tapered off your professional activities? d. Are you still active full time in your profession?

The later sixties are the most usual period of retirement; next come the seventies, next the early sixties; only one case earlier than sixty. Eight report tapering off.

C.11 Since your retirement what has determined your choice of a place of residence?

The commonest choice is to remain in one's former home. Influences mentioned are habit, family, friends, cultural advantages, civic activities. Some (chiefly women) go elsewhere to be near their children. Still smaller is the number of those who move to another state on account of climate.

Questions on Interests and Activities

In considering adjustment in old age we must recognize the importance of tolerable health and tolerable income. But even with these advantages life may be empty, lonely, boresome, and futile. Interests and activities are needed to give positive value to life .

What interests and activities do these respondents report that may contribute to their happiness in later years? Six items in the questionnaire have a direct bearing on this topic.

Question B.1. was addressed to both younger and older groups. It reads: *What are your present or prospective attitudes toward any or all of the following?* (see table 1).

The responses on sex were nearly all too brief to be significant.

The following "free-response" questions were also concerned with interests and activities. The "A" questions were mainly for the younger group and the "C" questions for the older group, so that the same person was not expected to answer both (see table 2).

A.2. What activities, avocations, hobbies, recreations, etc., useful or useless, income-producing or otherwise, do you now carry on that you hope to continue after retirement?

A.3. What activities of the above kinds do you hope to begin after retirement?

A.6. What are the chief pleasures or satisfactions to which you look forward in retirement?

C.9. In what do you take your greatest pleasure?

C.10. Since your retirement, what are the main activities, hobbies, etc. that you engage in? Which of them are income-producing?

A National Education Association Study of Later Maturity (1) reporting on a largely professional group, showed that reading was the most favored leisure activity, that visiting friends was more favored by women than men, and gardening more favored by men than women (p. 29).

In considering people's prospects of good adjustment in later years, it is important to consider the *number* of interests that each individual reports. Of course one interest may absorb more time or be more deeply satisfying than another, so that the mere number of interests is not a precise measure of a person's mental resources. But it is at least a partial indication.

Table 3 is based on the responses to all questions covered in the two preceding tables. Less than three interests are reported by 15 per cent of the respondents, three to ten by 72 per cent, and more than ten by 13 per cent.

Summary

A questionnaire was circulated in 1947-1948 to 950 persons consisting of listees in *Who's*

Who in America, successful professional people, and Vassar alumnae; most of the group were in their forties or their seventies. Responses were received from 130 in the first two groups and 43 in the third.

Responses secured by Hall in 1922 are compared with responses received in 1947-1948.

Similar responses from the two groups include: a) Symptoms of approaching age are various and begin at widely varying ages; increased fatigue is often mentioned. b) Heredity is the most frequently assigned cause for longevity. c) Care in eating is most often mentioned as an aid in keeping well. d) Serious regrets are rare. e) Temptations are few and rarely very serious. f) Reading is the most favored leisure activity. g) Responses to the question, "Would you live your life over again?" are predominantly optimistic. h) Very few think much or worry at all about death and the hereafter. i) Religious attitudes are rarely orthodox.

Responses showing contrast between the two groups include: a) Onset of age marked in first group often by external signs like gray hair, in second group, by some break in health. b) One person in first group and 40 in the second deny all regrets. c) In the first group no one is reported as denying that he felt old; in the second group, many deny feeling old, including some in their eighties. d) The second group shows more reliance on medical advice and on periodic physical examinations. e) The second group shows less aversion to church and clergy, but still shows little reliance on them.

Responses to questions added in 1947 include: a) About one-fourth of the professional people declare they will never retire unless forced by ill health; most of the others will retire or have retired between 60 and 70. b) Many of the middle-aged group plan to remain permanently in their present homes, and most of the older group are doing so. c) Interest and hope are the most frequently expressed attitudes toward later years. d) The middle-aged are concerned about income and health after retirement rather than mental preparation. e) Systems of compulsory retirement are favored, 104 to 19. f) Recommended preparation for retirement includes provision of annuities, care of health, and development of interests and hobbies. g) Tastes in reading tend to become more serious. h) Increased irritation is admitted by one-fifth of those who answer the question; increased tolerance is asserted by another fifth. i) The most favored

TABLE 1. COMPARISON OF INTERESTS LISTED IN B. 1.

(In each column the Arabic numeral shows the *percentages* of respondents interested in the activity; the Roman numeral shows the first three choices. The description of groups is given near the beginning of this article.)

Group Responding	Columbus Group	Who's Who 40+	Who's Who 70+	Total First 3	Vassar 40+	Vassar 70+ Home	Vassar 70+ Professional	Vassar Total
Number	64	33	33	130	9	15	19	43
Travel	34-III	72-I	48-II	49-I	78-I	47-I	69-I	64-I
Gardening	36-II	60-II	51-I	47-II	44	33-III	37	37
Physical Exercise	39-I	51-III	45-III	44-III	33	7	53-III	33
Visiting Museums	23	45	24	29	44	33-III	37	37
Observing Birds	15	36	24	23	56-III	33-III	53-III	47-II
Bridge	18	36	15	22	44	27	53-III	42-III
Fishing	22	48	24	29	56-III	0	11	16
Sex	23	45	15	27	44	0	0	9
Photography	23	33	15	24	56-III	17	11	21
Golf	22	36	18	25	11	7	17	12
Poker	8	21	3	10	0	0	11	5

TABLE 2. COMPARISON OF INTERESTS LISTED UNDER QUESTIONS A.2, A.3, A.6, C.9, C.10

(Arabic and Roman numerals have the same meaning as in Table 1)

Group Responding	Columbus Group	Who's Who Groups	Sum of First 2	Vassar Alumnae
Number	64	66	130	43
Reading	25-I	33-I	29-I	35-I
Writing	20-II	27-II	24-II	7
Friends	12-III	11	11-III	23-II
Club and Civic Activities	11	11	11-III	12
Family	5	6	5	19-III
Art, Craft & Shopwork	3	17-III	10	5
Church	2	3	2	14
Research	6	8	7	0

In addition to these, helping people, country life, motoring, music and housekeeping received scattered mention.

TABLE 3. VARIETY OF INTERESTS

Number of Interests	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Number of Respondents	2	7	17	24	25	15	19	20	10	11	14	3	5	1

AVERAGES

Group	Number	Average
Columbus	64	5.3
Who's Who 40 Plus	33	6.6
Who's Who 70 plus	33	5.5
Vassar Alumnae	43	6.0
Total	173	5.6

leisure activities include reading, travel, gardening, various physical activities, and various social activities. j) The average number of leisure interests is six; 15 per cent report fewer than three interests; 13 per cent report more than ten.

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The Medical Organization of the Modern Home For The Aged

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DR. ZEMAN DISCUSSES THE MEDICAL ORGANIZATION OF THE HOME FOR AGED AND INFIRM HEBREWS IN NEW YORK CITY AND EMPHASIZES THE VALUE OF AN AUTONOMIC STATUS OF HOMES FOR THE AGED IN RELATION TO A GENERAL HOSPITAL. THIS PAPER WAS GIVEN AT THE SECOND ANNUAL SCIENTIFIC MEETING OF THE GERONTOLOGICAL SOCIETY IN CHICAGO, NOVEMBER 5-6, 1949.

THE increasing number of aged individuals in the community presents complicated social, economic, and medical problems, whose solution demands intensive study and integrated activity on the part of many interested agencies. It is appropriate, therefore, to examine the functions of the modern home for the aged and to describe a type of medical organization which aims to serve old people according to their changing needs at different periods in their declining years. To define the relation of the modern home for the aged to other community medical resources is a necessary part of this discussion.

If we go back far enough in the history of medical institutions we reach a point in the twelfth and thirteenth centuries when hospitals were actually refuges for the indigent and sick aged. In England the word hospital is still used to designate certain homes for old people. One recalls at once the famous Hospital of St. Cross at Winchester, founded in 1132, as well as the Chelsea Hospital for old soldiers and the Greenwich Hospital for old sailors.

In Paris two great centers of medical teaching and research for over 300 years have been the Bicêtre, an institution for aged men, where Philippe Pinel on May 24, 1798, removed the chains from the insane, and the Salpétrière, housing thousands of aged women. Guillain and Mathieu in their history of this institution have said. "It has seen within its walls the men of the 17th, 18th, 19th and 20th centuries according to their successive conceptions, attempt to resolve the great problems of public and private charity, of aid to the poor and the aged, of the protection of society against the insane and defective, of the protection of the insane and defective against society."

Contrasted with the stirring traditions of French medicine, our own wretched almshouses of recent memory seem hardly comprehensible unless one recalls that they stem from the Old English Poor Law of 1603, passed in the last year of the reign of Queen Elizabeth. Homes for the aged have a rich medical tradition and in France, Germany, and England have participated notably in furthering the progress of medicine and in promoting the welfare of the community.

Today, the homes for the aged of this country, particularly those which are privately supported, are in a state of transition from boarding houses for allegedly healthy old people to institutions where the attitude of resignation and passivity has given way to one of aggressive and optimistic attack on the varied problems presented by old people. In describing such a program I shall of course draw largely on my experience of many years at the Home for Aged and Infirm Hebrews of New York City. This institution exemplifies the basic truth that ideas and attitudes are more important than fine buildings and abundant funds. The absolutely indispensable requirements are a board of directors possessed of courage, imagination, and initiative, and a staff,—medical, nursing, social service—inspired by faith in the value of the job to be done and unafraid of time-worn prejudices and the poorly concealed contempt of professional colleagues.

Dr. Frederic D. Zeman received his M.D. degree from the College of Physicians and Surgeons, Columbia University, in 1917. He is a diplomate of the American Board of Internal Medicine and fellow of the American College of Physicians. He is practicing internal medicine in New York City and serving as a member of the attending staff of The Mount Sinai Hospital and as Chief of the Medical Staff of The Home for Aged and Infirm Hebrews.

The population of the Home is at present about 500 individuals, of which 150 are able-bodied, housed in two Apartment House Projects about a mile away from the Main Building. Another 150 able-bodied or slightly handicapped persons are residents in the Central Building. One hundred and twenty-five severely handicapped are cared for in dormitories in the same building, while the adjacent Infirmary cares for 75 acutely or chronically ill patients. In this same unit are found our clinical laboratories and diagnostic x-ray installation.

We are equipped in most respects to do the same work as is performed on a medical service in a general hospital. Complicated diagnostic or therapeutic procedures as well as major surgery require transfer to the Mt. Sinai Hospital situated on the opposite side of Central Park. Our Infirmary is kept so busy caring for acute and chronic illness among our residents that we are not often able to admit sick old people directly to the Infirmary. We occasionally refer our patients to the St. Luke's Hospital and the Memorial Hospital. From time to time we are forced to avail ourselves of the resources of the Psychopathic Division of the Bellevue Hospital.

Our staff is organized according to the requirements of the American College of Surgeons, and our records, clinical pathologic conferences, and medical library are all in accordance with the standards of that examining authority, which has done us the honor of according recognition. Our program of physical hygiene includes preadmission physical examinations, careful checking after admission, and an annual examination of all residents. Our resident staff of three physicians hold daily clinics for the ambulatory and care for the sick under direction of the attending group.

Our mental hygiene program includes careful home studies by the Social Service staff before admission, Rorschach tests by our clinical psychologist after admission, and psychiatric examinations when necessary. Occupational therapy, physical therapy, recreational activities of many kinds, are all designed to rebuild the self-confidence of the newly admitted resident and to increase his sense of importance and value in our small community. A more detailed account of our activities in this respect is to be found in the chapter I contributed to Dr. Stieglitz' *Geriatric Medicine* on the Medical Care of the Normal Aged (4).

Due to the flexibility of our resources we are able to admit nearly every kind of aged individual who presents himself, our only limitation being that of space, which will be at least temporarily relieved by the opening of Kingsbridge House, a 400 bed addition to our facilities, located about seven miles from our Central Building. This new addition will be organized and operated in accord with the same principles already found effective, that of close cooperation with other medical institutions and social agencies, thus avoiding duplication of functions.

Our modest research program has been supported by donations from our board members, but has for the past year been supplemented by a grant from the Federal Security Agency. Because of our high percentage of postmortem examinations, (nearly 90 per cent) we are in a position to make many valuable clinical pathologic correlations, such as the high percentage, 20 per cent, of cardiac rupture in cases of myocardial infarction in a group whose average age was over 80 years (6).

Under the auspices of the College of Physicians and Surgeons, Columbia University, and in association with the Mt. Sinai Hospital, for the past five years we have given a course in geriatrics for practicing physicians consisting of 18 two hour sessions held one a week (5).

In addition we enjoy a formal affiliation with the Division of Nursing Education of Teacher's College, Columbia University. Graduate nurses studying for degrees in nursing spend one or two weeks each semester working with our patients and receiving instruction from the medical and nursing staffs. The School of Nursing of the Presbyterian Hospital has recently made the innovation of sending a group of undergraduate nurses to us for a brief indoctrination in the principles of geriatric nursing.

Other educational responsibilities of our staff include talks to our board of directors, with the particular purpose of indoctrinating new members, and contributions to the programs of nursing and social service agencies as well as to those of lay organizations. Special courses of instruction have been arranged for our resident staff.

However successful our efforts have been in the narrow area of our endeavor, it is quite obvious that institutional care of the aged in the narrow sense can never be a complete answer to the problem. The need is so great and buildings are so expensive that only by keeping the able-bodied and the partially handicapped aged in the communities can we properly utilize our institutions. This may be accomplished by setting up programs for extramural care under the auspices of a home for the aged in order that patients may be assured security when infirmity makes transfer necessary. We have had such a program in operation for the past year and a half and now have 20 individuals under our care. Our census has grown slowly, partly because of the unwillingness of many old people to accept care in their own homes once their minds have been made up to enter an institution.

The supervision of this program is a joint responsibility of the Medical and Social Service Departments. We furnish visiting social workers, visiting nurses, and visiting homemakers or houseworkers. In time we expect to add occupational therapists. Wherever possible the patients' own physicians, who are reimbursed by the Extramural Program, are called in. This method is our real hope for the future and we are devoting much of time and thought to its development and to eliminating the various operational difficulties that arise.

The exact position of the general hospital in relation to these problems requires further exploration because in the past we have experienced difficulties in having old people admitted to hospitals with which we enjoy close relationships. Sometimes there were no beds available, but just as often young admitting physicians could see no point in bronchoscoping a man of 80, or the chief of a service could find nothing of interest in the problems presented by a nonagenarian. Recently our relation to the Mt. Sinai Hospital was made official by action of the hospital's Board of Trustees, and the cooperation of the two organizations will be notably facilitated with benefit to our residents and the hospital's patients.

A recent commentator has advocated that the sick aged be cared for only in general hospitals and the able-bodied in a hospital directed outdoor program (2). Until such time as the number of hospital beds catches up with the need for them such a program will not be possible. I have recently discussed the value of special geriatric study groups in general hospitals (3). Even if otherwise possible it is economically unsound to care for long term aged sick in expensive general hospital beds. The hospital for chronic diseases is likewise poorly suited to this task because its costly beds are apt to be filled with custodial cases and patient turnover is small. Only by careful cooperation between social service and medical departments can many of these difficulties be ironed out.

Our solution has been a peculiarly individual one and is presented simply as an example of one that seems to be working fairly well. Every community has its own problem to utilize its facilities to their maximum and to integrate all its agencies in the interests of the aged. It is our belief that the autonomy of the home for aged in relationship particularly to the general hospital and the hospital for

chronic diseases encourages the development of organizations that are centered on the total individual rather than on sicknesses. The independent home for the aged will seek to become a community center for older individuals of varying needs, whether residents or not, and will build a flexible program based on the sound principles of mental and physical hygiene and thus continue to grow by continually seeking and testing new approaches, new techniques, and new areas for attack.

In conclusion I would like to call attention to a stimulating paper by Dr. Leo Alexander of Boston on "Medical Science under Dictatorship," in which he points out the dangers of utilitarian thinking with relation to present day medical attitudes regarding the aged and the chronically ill. He says, "A certain amount of rather open contempt for the people who cannot be rehabilitated with present knowledge has developed. This is probably due to a good deal of unconscious hostility, because these people for whom there seems to be no effective remedies have become a threat to newly acquired delusions of omnipotence." And further he advises, "American medicine must realize where it stands in its fundamental premises. There can be no doubt that in a subtle way the Hegelian premise of 'what is useful is right' has infected society, including the medical portion. Physicians must return to the older premises which were the emotional foundation and driving force of an amazingly successful quest to increase the power of healing and which are bound to carry them still farther if they are not bound down to earth by the pernicious attitudes of an overdone practical realism" (1).

Summary

A survey is given of the medical organization of a modern home for the aged. The relationships of old age institutions to general hospitals and to hospitals for chronic diseases and the importance of cooperation with social services are discussed.

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HISTORICAL SECTION

ANDREAS LAVRENTIVS HENRICI IIII GALL. ET NAVAR. REGIS CONSIL. ET MEDIC. PRIMARIVS
Vultum Laurenti cernis sub imagine scriptis
Viuini Ingenij conspiciuntur opes.

ANDRÉ DU LAURENS (1558-1609),—eminent French practitioner, physician to Marie de Medici and Henri IV, is noted for his contributions to the medical care of the aged. His work was translated into English by Richard Surphlet in 1599 and is entitled Discourse of the Preservation of the Sight; of Melancholike Diseases; of Rheumes, and of Old Age. Although a thorough Galenist, du Laurens did not hesitate to contradict established opinions when not verified by his own observations. "The men of Egypt and Alexandria did believe that the naturall cause of olde age did come of the diminishing of the heart, they said that the heart did grow till fiftie yeares the weight of two drames every year, and that after fiftie years it waxed lesser and lesser, till in the end it was grown to nothing; but these are nothing but vaine imaginations and foolenes. We have caused many old men to be opened, where hearts have been found as great, and heavie as them of younger sort."

F. D. Z.

CURRENT COMMENT

Pension Questions

The current drive for old age security brings up a number of questions. How much real security is there in the pensions which the unions have recently achieved? The new pension agreements obligate the employer to pay pensions only as long as business is good. What assurance does the employee have that funds will be available for a pension when he retires? Or that the nation's economy will remain the same and the amount sufficient for his needs years from now?

Even if the next pension demands obligated the employer to make pension payments regardless of business conditions, how could the employer keep such an agreement during a depression or if the company went bankrupt or was liquidated?

Most company pensions are based on a stated number of years of continuous service to one company. How many employees can qualify? Should the requirement for years of service be lifted, will it mean excuses for employee layoffs so that pensions will not have to be paid when they fall due? Will it mean discrimination against the hiring of older people? Such discrimination against the older employee might have the support of the younger employee as well as the employer. Could workable laws against age discrimination be enacted? It would be difficult to prove bias. And in some jobs younger men are more efficient, so laws requiring employers to hire less efficient men might readily be found unconstitutional.

The pension plan which requires twenty-five years of continuous service discriminates against people between 30 and 40 as contrasted to those between 20 and 30, but does not discriminate against anyone over 40. The plan which gives a pension proportionate to the number of years employed, such as that in effect at many universities, does not discriminate against any age group, but the amount of the pension is usually not adequate. However, since the money is administered by an independent insurance company, the possibility for a satisfactory pension plan on this basis does exist. The third possibility is a plan whereby everyone on retirement would receive a pension irrespective of the time of employment; such a plan would not discriminate against older workers.

Funding pension plans would provide a reserve of money to insure payments. But where would the money for such a fund come from? Such funding could only come out of company profit and yet a staggering sum would be needed to cover past service. In many cases the past service reserve fund would have to be greater than the company's entire capital investment. Even if such large reserves could

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The hieroglyphics, "The Beginning of the Book for Transforming an Old Man into a Youth," at the top of this editorial page, are from the Edwin Smith Surgical Papyrus, translated by Professor John Breasted, University of Chicago Press.

magically be acquired, there would still be the problem of investment of such funds. If the reserves were invested in government bonds, would it cause inflation? If the reserves were invested in the securities of the company promising the pensions, payment would still depend upon the company's ability to pay when the pensions fall due. Even a plan based half on a pay-as-you-go and half on funding would still impose major risks.

A government plan for pensions would eliminate some of the difficulties inherent in private pensions—and raise others. A federal plan would be fairer. It would not discriminate against the hiring and keeping of older people on the payroll. It would give the employee a pension regardless of the length of continuous service with a particular company and regardless of the company's ability to pay at the time. And it would give a pension to employees of small business as well as the large ones.

However, such a plan would decrease the amount of money available for capital investments. And there would be no assurance that the government would not use the fund for current expenses. The 14 billion dollars paid in under the old age benefit section of the Social Security program has all been spent. True, almost 12 billion of the 14 has been placed in government bonds as required by law. But the money thus invested in government bonds has gone out to cover general government expenses, depriving our national economy of the necessary capital investment.

Then there is the question of who is to pay the pensions. Isn't it the public who pays the private pension plans in the increased cost of the products of the various companies? Funds for payment of a federal plan would have to come from the sale of bonds to the public and/or taxes, thus raising the question of whether the same individual would be taxed twice for his old age checks and also where funds could be obtained in the event of a depression when the government would collect lower tax totals and yet would have to pay out more in social security payments.

Provision for older people who are not able to work will have to be made, but if more emphasis is placed on keeping the older worker productively employed for as long as possible there should be less necessity for pensions.

Age Factors in Accidents

You're not safe on Maim Street at any age the Travelers Insurance Company reports; 31,800 people were killed in street and highway accidents in 1949. Of these 4,380 were age 65 or older, roughly 1 out of 7. In comparison, of the total population of the United States, approximately 1 out of 13 people are more than 65 years old. Of the group aged 65 and over killed in traffic accidents in 1949, the largest percentage (51.8) were pedestrians. This is the highest percentage for any age group, although it represents a decrease from the 1948 percentage of 59.4 (also the highest for any age group).

Persons injured in traffic accidents in 1949 totalled 1,564,000, of whom 73,820 were 65 years or older, or 1 out of 21. While a total of 400 fewer people of all ages were killed in such accidents in 1949 than in 1948, 93,000 more people were injured last year than the year before. This is reflected in the older age group too, the number of injured persons over 65 in 1949 exceeding the figure from 1948 by 4,680.

Some insurance companies have a higher premium rate for cars driven by people under 25 years and over 65. After the war young drivers from 18 to 24 years old began causing more than their share of automobile accidents. By 1947 the trend was well established, in 1948 the peak was recorded, but in 1949 the percentage for this age group was down. On the contrary, however, the percentage of drivers 65 and over involved both in fatal and in nonfatal accidents increased (fatal accidents, 1,360 in 1948 to 1,710 in 1949; nonfatal accidents, 35,810 in 1948 to 42,020 in 1949). The total number of drivers of all ages involved in fatal accidents was down in 1949, but the total number of drivers in nonfatal accidents was up.

Industrial safety records show that the average age of victims in fatal accidents is 46. Since the average age of heart disease victims is 68 years and of cancer victims 63, based on life expectancy tables of insurance companies, industrial accidents cut 20 more productive years from lives than these two diseases.

Added Lives, Not Added Years

The Census Bureau estimated in March that of the 148,720,000 persons in the United States in mid-1949, 11,270,000 were more than 65 years old, an increase of 320,000 since 1948.

Based on 1948 death rates, the Public Health Service has stated that the average white women in the United States now lives 71 years (70.5 in 1947) and the average white man 65.5 years (65.2 in 1947).

The Federal Security Agency computes the average length of life in the United States as 67.2 years, based on the 1948 mortality figures (the 1947 average life was 66.8 years). In every age group the death rates for males are higher than those for females, and except for the age groups over 75, they are higher for the nonwhite population than for the white.

These figures might indicate that years have been added to the individual life span, but a glance at other statistics reveals that the increased life expectancy is largely because more people escape the infectious diseases of early life and live to grow up. The decline in the death rate since 1940 has been greatest—more than 40 per cent—for children from 1 to 4 years old. Beginning with the age decade 35-44, however, the declines in the death rate since 1940 grow smaller with advancing age.

San Francisco Senior Recreation Center

The need for recreation for older people has been recognized and met in San Francisco, and the way in which this was achieved may serve to stimulate similar activity in other cities.

A Study Committee appointed from the Group Work and Recreation Council of the Social Planning Committee of the Community Chest made a survey of the number of older people in the community, where they lived, their needs, and which agencies in the community were serving them. At the same time an elderly man started out to interest the City Recreation Commission, councilmen, philanthropic foundations, and social agency executives in his idea of a recreation center for old and lonely individuals. Finally a young news editor of a daily paper listened sympathetically and wrote an editorial and news story which opened the way for old people to join together at one another's homes for social evenings and picnics in the parks.

Then, with the Chairman of the Study Committee serving as agent, the American Women's Voluntary Services, looking for a peace time project to sponsor, was interested in the idea of helping to fill the recreation needs of older people. The survey made by the Study Committee showed a large concentration of older people living in an area where there was a city-owned waterfront park and recreation building unused since the war. Commissioners' facilities in the building were granted and a trained group work administrator was employed for an experimental period of two years and paid by funds from a grant from the Columbia Foundation.

The San Francisco Senior Recreation Center started in October, 1948, with a group of fifty people and now has a membership of over a thousand men and women from 60 to 89 years of age. It is open five days a week with activities scheduled until 10 o'clock on two evenings. Card playing, handwork, reading, and visiting are popular activities. In addition, through the cooperation of the Adult Education Department of the public schools skilled teachers were secured for hobby groups in folk dancing, glee club, leathercraft, ceramics, painting, dramatics, personality development, psychology, and book reviews.

Other community agencies refer their elderly clients to the center. Medical social workers, visiting nurses, caseworkers in the Public Welfare Department, the Council of Churches, neighborhood centers, and the Travelers Aid

all recognize the therapeutic effect on their elderly clients of visits to the Center.

Baltimore Comes of Age

Baltimore's Peale Museum, the museum of the life and history of Baltimore, offered a program concerning the problems of our aging population in the form of an exhibit from April 13 to May 7 and a series of four lectures on the general subject of Baltimore Comes of Age by such well-known authorities in the field of gerontology as Dr. Edward J. Stieglitz, Dr. Nathan W. Shock, Miss Ollie A. Randall, and Ewan Clague.

In the Museum's April Bulletin the problem and a sketch of the possible solutions to the consequences of the age-shift in the American population is presented. It is pointed out that in ten or twenty years there will be as many people over 65 years of age as there will be children under 5 and that if mortality rates continue to improve at the present rate and if the birth rate continues its long range downward trend, in the year 2000 there will probably be twice as many people over 65 as there will be children under 5, and there will be as many people over 44 as between 20 and 44. The working population will be mostly middle-aged.

It is emphasized that the medical problems of old age are not even half of the total problem—any gains in lengthening the life span or in reducing the tolls of the chronic diseases will only intensify the social and economic problems which are already more acute than is generally realized. The suggestion is made that there should be no arbitrary retirement age but that employers judge a man by his capacities, not his birthdays; that the individual organize his own life pattern to suit his changing physical and mental capacities, and that the individual make financial plans for his future. Finally, Baltimore's contributions to the welfare of her aged population is discussed.

News and Notes

The first nation-wide conference on aging, to be held in Washington, D. C., August 13-15, is being arranged by Federal Security Administrator Oscar R. Ewing at the request of President Truman. Several hundred people interested in various phases of the problem are being invited to attend and four work sessions will be held by these delegates on each of the phases of the subject.

The third edition of *Problems of Ageing*, previously edited by Dr. E. V. Cowdry, is being prepared under the editorship of Dr. A. I. Lansing. The title of the third edition, which is expected to be completed by the end of 1951, will be modified to *Cowdry's Problems of Ageing*.

Two new courses on aging are being given this summer by Mrs. Ruth Laverty at the School of Education of New York University, Problems and Adjustment of the Aging in Contemporary Life (July 3-21) and New Developments and Resources for the Aging and Aged in Contemporary Life (July 24-August 11). Information may be obtained from Associate Professor Esther M. Hilton, School of Education, New York University, Washington Square, New York 3, New York.

The New York State Geriatric Research Program will be based on a five to ten year study covering a thousand patients aged 61-69. Among the first projects are calcium metabolism, hormones, cardiovascular changes, and fat-protein metabolism.

Grants-in-aid totaling $220,000 have been awarded for heart disease research to 46 universities, hospitals, institutes, and laboratories by the American Heart Association. These grants bring to approximately $400,000 the total funds voted by the American Heart Association during the past year for research to be conducted in the academic year 1950-1951. This total does not include research funds in-

dependently allocated by affiliated local heart associations as part of their regional programs.

The American Geriatrics Society held their 1950 convention June 1, 2, and 3 at the Hotel Commodore in New York City.

The American Society for the Study of Arteriosclerosis will hold their annual meeting at the Hotel Knickerbocker, Chicago, Illinois, November 5-6, 1950.

The Third Annual Scientific Meeting of the Gerontological Society, Inc. will be held November 12 and 13 in St. Louis at the Washington University School of Medicine. There is no registration fee and everyone interested in the problems of aging is invited to attend.

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Activities of the Finnish Gerontological Society

The Finnish Gerontological Society was established March 22, 1948, after a preliminary meeting held in December, 1947. The activities of the Society were planned from the beginning to comprise many different disciplines, not only those connected with natural sciences or medicine but with humanistic, cultural, and socio-economic sciences as well.

One of the first measures was to hold a symposium on quite a small scale in April, 1948, in cooperation with the Finnish Medical Society, Duodecim, which occasion papers on the physiology of aging and geriatric surgery were read. The statistical data collected by Oravisto from the Surgical Clinics of the University of Helsinki clearly illustrated the fact that the age distribution of the surgical clientèle had undergone a great change in the course of the last decades and showed a growing percentage of patients over 50 years of age. An increasing tendency to operate on older persons had caused only a slight, hardly significant, increase in the surgical risks, probably owing to the parallel development of surgical technique.

At the following meeting of the Society a paper dealing with the demographic structure of the population in Finland and its development was read by Tunkelo, who pointed out that the percentage of people over 65 years old in Finland is only 7.1, but that a steady increase in the older age groups has been clearly established. The form of the population pyramid, which in 1910 was still a perfect pyramid with a large base, by 1947 had become constricted near the base, the age groups from 5 to 39 years being all of about the same size. As a consequence of the new high in nativity reached in the postwar years, the age group 0 to 4 years is still the most numerous. An approximate estimation of the economic status of those over 65 years old was also given. It was noted that about 40,000 had been taxed and may be supposed to have some income of their own, and about 18,000 enjoyed institutional care and subsidies, although usually very moderate ones according to the poor law statutes. The remaining 125,000 persons had no personal income and were supported by their relatives.

Tawast and Orma presented data concerning corneal sensibility at different ages. On the suggestion of the reviewer they developed at the Institute of Physiology of the University of Helsinki a method in which an air puff of exactly measurable duration and pressure was used as a stimulus. The obtained pressure-duration curves showed a decreased corneal sensibility in the group 70 to 80 years old, the curves for these old subjects lying above the curves for children and young persons. Sometimes there was an overlapping of the values for children and old people. Especially in experiments of short duration the dif-

ference between the various age groups was definite.

A preliminary report on isoagglutinin titres in Finnish families was given by Renkonen and Tuomioja. According to these studies a conspicuous fall in the titre values with age was established, and moreover the material displayed a pronounced difference between the two sexes. Mothers and daughters had on an average a higher isoagglutinin-titre than their brothers, husbands, and sons. The decrease with advancing years is, however, steeper in women; therefore in old age the difference between the sexes is less distinct.

At the beginning of the year 1949 the legislative aspect of old age in Finland was reviewed by Mustala, who presented data concerning the care of the old according to the present law. At the first annual meeting of the Society in March, 1949, Karsten lectured on psychology of the aged and Tawast-Rancken speaking about gymnastics for aging people, stressed the necessity of developing special programs of exercises for the elderly taking into account the different physiologic conditions, particularly of the connective tissues in aging women. The main principles to be followed and a few examples of suitable forms of exercise for the old were presented.

Palmgren, in a review on the physiologic and natural length of life in animals, summarized the problem of potential immortality in the conclusion that a continued life is possible as long as the cellular structure can be thoroughly reorganized through fertilization, endomixis, naturally or experimentally enforced reorganization (amputation), vegetative propagation, or even through simple mitosis. The factors limiting mitotic capacity in somatic tissues to not more than about 30 successive divisions in the brain of man are unknown.

Rubner's rule about longevity and the rule that the product of temperature and developmental time or span of life is a constant in poikilothermic species seem to imply a fatal wearing-out of the living substance through a certain amount of energy transformation. However, in animals remaining alive in an inert status no accumulation of noxious metabolites nor any wear and tear of tissues seems possible. Since their ability to survive at low temperatures is not unlimited, some other kind of changes must be assumed, perhaps of the same kind as the mutations, or intramolecular changes. Normal aging may be due to an accumulation of corresponding irreversible changes in vital components of the protoplasm.

The mean longevity under natural conditions is, as demonstrated by bird banding, surprisingly low. The immensely increased mean longevity of man has emancipated him from the pyramid of numbers typical for biota in natural equilibrium. Aging and death are, as Palmgren points out, generally thought of as signs of biologic imperfection. The limitation of the life span should, however, according to him, be considered as adaptative.

The more numerous the generations of a species in a time unit, the greater are the number of mutations submitted to selection and the greater the genetic plasticity and ability to survive under altered conditions. The long-lived animals (such as man, elephants, big tortoises) all belong to the top of producer-consumer chains; their food does not run away nor hide, and their large size makes them fairly insensitive to lack of food or unsuitable temperatures of short duration. Such species do not need as high an adaptability as other animals, and their span of life can be longer without impairing their viability in the struggle for existence.

Ehrström discussed gerontologic aspects of life in Greenland. He has made a medico-statistical study of the population in Umanak and compared the data thus collected with a similar material collected from a fairly solitary district in the Finnish archipelago with a population of fishermen. The scarcity of arteriosclerosis in Greenland as compared with the incidence of it among similar age groups in Finland was quite striking. An exceedingly early onset of external symptoms of old age and the small number of old people in Greenland were characteristic of the population.

The reviewer has investigated the influence

of age upon certain typical features in the phantom limb phenomenon of arm amputees. It was observed that in the 17 to 24 years old amputees there was a higher frequency of adaptable phantoms than in the age group of amputees 25 to 45 years old. This difference was particularly clear if the examination was made within six months after amputation. In the older age group the phantom arm appeared more rigid, fixed, and not to be altered by changes in the external situation.

At the last meeting, held in December, 1949, the reviewer presented results of an investigation covering 18,000 cases collected from Finnish and Swedish genealogies in which the span of life and the age of both parents at birth of their offsprings, as well as the span of life of the offspring, was known. This material clearly reveals the influence of maternal age at birth on the average length of life of the offspring.

If first-born children and deaths during the first year of life are omitted, one more year in the age of the mother shortens the average length of life of the offspring by 0.28 years. If the deaths during the first year of life are taken into account, the increase in maternal age shortens the expectation of life at birth (and later) even more (about 4 months). The age of the father has on the whole no significant influence on the expectation of life of the offspring. If only children of short-lived mothers are tested in this respect, an influence of the age of the father is, however, probable. Only the genetically short-lived seem to form a population sample sensitive enough to reveal slight deletarious influences, such as high paternal age.

It was pointed out that this difference between the effect of maternal and paternal age is easily explained by the fact that the ova are preformed and already existing at birth of the mother and consequently subject to aging. The aging of the ovum might manifest itself in an increased incidence of mutations occuring in the development after fertilization. The viability of the offspring may then be lowered. In the father the spermatogenesis continues throughout life, and the aging element is the germinative tissue and not the reproducing cells, the spermatozoa themselves. If the incidence of mutations increases with advancing age, the result must be a greater amount of abnormal spermatozoa. Only part of these may have retained their fertilizing capacity and may pass on the vitiating mutations to the offspring—hence the lesser influence of paternal age upon the length of life of the offspring.

Soininen gave an introduction to the history of gerontology in Finland by commenting upon certain papers published by Rabbe in the middle of the nineteenth century dealing with extreme old age. Rabbe was the first to compute and treat demographic data in Finland, although an official registration of causes of death had existed in this country since 1751.

In September, 1948, the Executive Committee of the Society presented a paper to the chairmen of the parliamentary groups stressing the need for coordinated studies in gerontology. The members of the Diet were notified of the difficulties in starting such studies because of the total lack of gerontologic literature in the public libraries and the lack of information as to the conditions of living, state of health, and economic resources of the old in Finland. It was stated that the need for investigations in these topics was urgent but not possible without financial support from the State. The parliamentary groups were requested to use their petition right and urge for subsidies for gerontologic research.

In February, 1949, the matter was taken up by certain members of the Diet, particularly by Borg-Sundman and a petition based on the suggestions of Societas Gerontologica Fennica was presented. In March the Ministry of Social Affairs appointed a state committee to "investigate and make propositions concerning the care of old people in Finland." To this committee two members of Societas Gerontologica Fennica were nominated.

The activities of the society have been made possible by grants from the insurance companies Salama, Suomi, Kaleva, and Pohja.

A subsidy from the State has made it feasible to publish a year-book named Geron, the first issue of which appeared in December, 1949. This book contains most of the papers read at the meetings of Societas Gerontologica Fennica and short notices on different gerontologic topics: physiologic alterations during aging, news concerning the establishment of foreign gerontologic societies, etc. The papers in the year-book are printed either in Finnish or Swedish.

EEVA JALAVISTO

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BOOK REVIEWS

EMPLOYMENT PROBLEMS OF THE ELDERLY

NEVER TOO OLD, New York State Joint Legislative Committee on Problems of the Aging, Legislative Document No. 32, Albany, 1949, 216 pages, paper bound.

In this, its second publication, the committee headed by State Senator Thomas C. Desmond has again made a substantial contribution to the solution of the problems presented by our aging population. Birthdays Don't Count, its first effort in this complicated field, presented the views of experts on a wide range of social, economic, and medical problems and explored the possibilities of certain avenues of State action. The present volume, comprising over 200 well illustrated pages, is devoted to the employment problems of the elderly and to recommending a definite State program. Senator Desmond points out in his introduction, however, that "the active co-operation of enlightened industry and labor is needed if any governmental action along such lines is to succeed."

Excellent presentations on various aspects of the employability and employment of older members are given by Dr. Charles A. Pearce, Director, Division of Research and Statistics, New York State Labor Department, by Carroll E. French of the National Association of Manufacturers, by William Green of the American Federation of Labor, by Dr. Howard A. Rusk, famous authority on rehabilitation, by Dr. Nathan W. Shock of the United States Public Health Service, and many others. Abundant statistical information has been provided as factual background. Many myths are here laid at rest particularly those dealing with the alleged benefits of retirement and of pensions, as well as the often mentioned higher insurance rates for older employees.

An appendix is devoted to transcripts of legislation recommended by the Committee, comprising seven bills in all. These provide for a state council on the elderly, for a geriatrics and adult hygiene division in the State Health Department, for amending the social welfare law to encourage establishment of recreation centers, for establishment of a counselling service for older workers in the Labor Department, for amending the tax law exempting contributions to retirement plans, and for amending the labor law creating an office for employment of older workers.

Copies of this valuable document may be obtained as long as available by writing to Senator Thomas C. Desmond, Newburgh, New York.

F. D. ZEMAN

REFERENCES ON WELFARE OF THE AGED

A SELECTIVE BIBLIOGRAPHY ON THE WELFARE OF OLDER PEOPLE, The Welfare Council of New York City, New York, 1949, 46 pages, paper bound, $1.00.

Workers in the field of old age are deeply indebted to the Welfare Council of New York City for its overall leadership and for its many unique publications. This selective bibliography on the welfare of older people continues a rich tradition of service to the whole country in providing a guide to the literature for "students in schools of social work, practicing caseworkers in family agencies, staffs and boards of institutions caring for aged persons as well as workers and volunteers in other community programs."

The listing of references is divided into various sections, such as case-work and coun-

selling, community planning and organization, employment and preparation for retirement, financial aspects, health, housing, recreation, leisure time activities and occupational therapy, social and personal adjustment. Appendices cover additional bibliographies and periodic publications in the field with their addresses.

The editor, Marion S. Halsey, and her collaborative committee have, in general, done their job well. Any criticisms are intended to be constructive. From the physicians' point of view, however, the health section is decidedly too brief in the coverage. A complete lack of historical orientation is likewise very apparent, particularly noticeable in its omission of all but one of the publications of the late Abraham Epstein, who almost single-handedly brought about the passage of the first state old age pension laws. Another regrettable hiatus is the absence of any reference to the many fine literary treatments of old age of which Miss Mary Ellen Chase's The Plum Tree is a recent notable example.

In general one gets the impression that this work is less selective than its title implies because of the inclusion of papers and books of questionable value. The real aim of such a listing is to present the really worth while material in order to save the beginner the hopeless task of plowing through a mass of repetitive and derivative contributions rather than to enumerate every last little paper on the subject merely for the sake of completeness. The present reviewer also believes strongly in the value of the annotated bibliography, which gives the reader a much better idea of what each author has attempted and also of what must be read and what may be omitted.

F. D. ZEMAN

SOCIAL ASPECTS

PROCEEDINGS, National Conference of Social Work, 1949 (Two Volumes), Columbia University Press, New York, 1950, 312 pages and 389 pages, $4.25 for Volume I and $4.75 for Volume II.

For the first time, the National Conference of Social Work is publishing its proceedings in two volumes instead of one. The first volume, which is called The Social Welfare Forum, contains all of the papers which were read at the general sessions of the conference held in Cleveland in June, 1949. The second volume, entitled Social Work in the Current Scene, contains 36 papers selected out of 135 given at the sectional meetings. The criteria for selection were "timeliness, pertinence, authenticity, and significance for present day needs."

The volumes contain very little specifically relating to the aged but a great deal of important background material useful to one working on problems of the aged. In the first volume such topics as Freedom with Security, Unique Possibilities of the Melting Pot, Social Goals for America, and How Much Social Welfare Can we Afford? are covered by Paul H. Douglas, Margaret Mead, Louis Wirth, and Eveline M. Burns—all outstanding authorities.

The second volume covers a wide variety of topics such as medical care and programs, social security, housing, and a great deal of material on methodology in social work.

The Proceedings of the National Conference of Social Work are a standard reference in almost all libraries and are useful on the personal bookshelves of those whose work involves people and their welfare.

B. E. YOUNGDAHL

SOCIAL SECURITY

THE AMERICAN SOCIAL SECURITY SYSTEM, Eveline M. Burns, Houghton Mifflin Company, Boston, 1949, 460 pages, $4.50.

Professor Burns' new book succeeds admirably in achieving her objective of a combination of survey and analysis of the entire

field of American social security. Her objective was the more ambitious since, unlike Gagliardo, she has not limited herself to the narrower sphere of social insurance. She introduces her subject with three chapters under the general title, The Need and the Response, that present the argument for social security and a general outline of the American system.

Successive groups of chapters, arranged in Parts, are concerned with the social insurances, income security for veterans, and the public assistance programs. The two concluding chapters, titled The Decisions that Lie Ahead, present at once a brief review and critique of the American system and a statement of the author's hopes and recommendations. No writer as competent in analysis or as devoted to the philosophic approach as Professor Burns could write a single page without reference, direct or indirect, to her basic philosophy or without implying critical comment; these final chapters nevertheless are the two most important in the book.

Her major adverse criticisms of the American system may be fairly summed up as follows: it is illogical, particularly on the financial side; coverage is highly incomplete; benefits are generally inadequate; administrative organization is needlessly complex and cumbersome, and confusing and irritating for officials, claimants, and the public. A formidable battery indeed, and on the whole, well supported, but the author does not despair. Her impatience with the irrationality of our system, in view of the way social security programs everywhere are in fact made and from time to time changed, and particularly in view of her statement of the special problems here (p. 437), seems unwarranted. The Europeans have had social security much longer than we, and except for the British continue with systems often the very reverse of rational. Decisions in this field, as the author herself suggests, are essentially political, and political decisions made piecemeal are especially likely to result in lack of logic.

Although she does not specifically say this, Professor Burns is clearly in favor of extending as far as possible the social insurance as distinct from the social assistance approach to social security—this despite its inherent limitations and the restricted role for insurance that results. Her analysis of suitable criteria of insurance benefit adequacy is particularly useful in an area in which far too many decisions in the past have been made by people who knew what they wanted but were not technically equipped to make decisions soundly.

Perhaps her most serious criticism of the American system is of what she considers a violation of sound social assistance principles. She believes that the specialized social assistance programs (for the blind, the old, the dependent children) with all but a few exceptions retain far too great an element of administrative discretion in determination of eligibility for and the amount of benefit. She would substitute what she calls a system of income-conditioned pensions, under which as in "social insurance . . . the standard payment is written into the law [and] which also specifies in considerable detail precisely what resources (amount and nature) will disqualify the applicant or reduce his payment by a stated amount" (p. 406).

This proposed system, in the interest presumably both of administrative objectivity and of heightening the resemblance to insurance, would also eliminate all responsibility of relatives for the support of assistance applicants. Experience is clear that this reform would do much to minimize the discretionary factor in assistance administration. Professor Burns does not seem concerned with the parallel, not too strained, that is suggested with Townsend or other "pure pensions" that would certainly develop. She would provide also for federal subsidy, on the same basis as for other public assistance groups, for state payments to general or residual assistance claimants. The categoric programs, having achieved their objective of special and preferred treatment for each of the specialized groups, are on their way out in any case, and the current discrimination against general assistance is unfair as well as illogical.

In a book as short and covering a realm as wide and complex as this, there are, as the author warns in the Preface, bound to be many chances to stub the auctorial toe. Background must frequently be subordinated so far (as in the story of the transformation of merit rating to experience rating in unemployment insurance—from stabilization device to social cost allocator to plain employer tax) that the reasons for the special nature of the current institution will not be clear to the novice. Some chapters, such as Chapter VIII, because they cover areas not within the author's personal experience, smell a bit of the lamp.

Sometimes generalizations are too sweeping. For example, the statement on page 105 that in private insurance the beneficiaries alone pay for their benefits; on page 38 that there is no malingering or rehabilitation problem with the permanently disabled beneficiary; on page 136 that the purpose of one of the federal suitable work standards in unemployment insurance is to prevent downward pressure on existing labor standards. In this last instance the more accurate statement would seem to be that its purpose, since a free and healthy labor market requires adjustment, gradually if possible, of the disequilibrium between men and jobs, is to regulate and for a brief period mitigate down-pressure on standards or down-grading. On page 203 she overlooks the important fact that we have workmen's compensation insurance funds in this country; on page 209 she says incorrectly, I believe, that legal advice is usually necessary for the worker with a workman's compensation claim (advice is desirable for serious cases but these are less than 1 per cent of all claims).

The fact remains: this is a first-class contribution to American literature in the field.

C. A. KULP

CHURCH PROGRAMS FOR THE ELDERLY

THE CHRISTIAN RELIGIOUS EDUCATION OF OLDER PEOPLE, Paul Benjamin Maves, Federal Council of the Churches of Christ in America, New York, 1950, 96 pages, paper bound, offset printed, $1.00.

The ninety-six pages of this book pose the problem of the church in "adding life to the years" for its older participants. More specifically it reports the experience of some thirteen Methodist Churches in their provision of services for their older members. The churches were chosen "to represent as wide a variety of situations, types, and sizes of churches as possible." Over a period of eighteen months the author observed the progress or absence of progress in programs of service to older persons.

While Maves served in an advisory capacity to the ministers of these churches, there was no attempt to institute any uniform program. Further, at no time did he take over the direction of any program. Maves confined his efforts, first, to the securing of certain basic data about each church and the community which it served, and second, to discussing with the ministers the problems of the elderly and possible ways by which the church might meet these problems. No authoritative relationship existed between Maves and the pastors. There was no prodding of the local pastor since the purpose of the investigation was to observe what types of service might be developed by the church and minister, once the latter's attention had been directed to the presence of problems among the elderly.

Maves' conclusions following the experiment would suggest that an eighteen month experiment resulted in no marked changes in the programs of the thirteen churches. But six experimental programs were proposed. Three of these never materialized in any continued program. Of the three successful experiments, one church organized an older women's Bible class, but the recreational program of another church and the sewing circle of a third soon lost their distinctive service to the elderly.

One might conclude from these reports that pastoral imagination was limited in making any departure from traditional programs as new needs were sensed. In fact to the reviewer it seems that at least half of the ministers never really sensed any problem which called for departures from the traditional program. Maves was forced to observe that "much of the program for older people was of a rather grim and serious nature, having fallen into an exploitive pattern for the sake of the church as an institution rather than being related to the needs and interests of the people."

In place of these grim programs Maves suggests that many items from such programs as those conducted for the elderly in Cleveland under Oscar Schulze, or at community centers and at neighborhood houses, would have greater meaning to the elderly and give fulness to their ebbing years. Time and again there is revealed on the part of ministers a lack of awareness of "the dynamics of social grouping"—witness the practice of "walking the plank" at the age of 40 in one young adult class with no provision for a close fellowship group above this age.

While the book should be read by every minister and worker in religious education it also has much to offer all persons concerned with programs for those in later maturity.

E. H. MOORE

THROMBOTIC VASCULAR DISEASE

THROMBOSIS IN ARTERIOSCLEROSIS OF THE LOWER EXTREMITIES, Edward A. Edwards, Charles C. Thomas, Springfield, Illinois, 1950, 74 pages, $2.00.

This monograph (Number 41 of the American Lecture Series) is designed as an up-to-date guide to the understanding and clinical management of an important geriatric problem, thrombotic vascular disease of the lower extremities. As in the case of all diseases of advanced age, the physician will be confronted with increasing numbers of persons suffering from this condition. In the preface it is pointed out that the arteriosclerotic individual usually escapes severe disability or gangrene until thrombosis occurs in the diseased arteries. A greater awareness of the frequency and seriousness of thrombosis should aid in the prevention of gangrene and of extreme impairment of function.

The etiology and pathologic anatomy of this condition are well covered in the light of modern knowledge, and the author draws on a wide clinical experience in his discussion of diagnosis and treatment. It is well known that gradual narrowing of the vessels may progress over a long period of time without giving rise to acute symptoms until occlusion suddenly develops as a result of thrombosis. The internist dealing with old persons may feel that too little space is given to the management of patients with chronic ischemia of the limbs but without thrombosis. However, as the title indicates, the monograph is primarily concerned with the clinical picture, differential diagnosis, and treatment of established thrombosis. The author stresses the importance of immediate lumbar sympathectomy for relief of ischemia, to prevent propagation of the thrombus and venous thrombosis, and to prevent sequelae such as increased severity of intermittent claudication. The use of anticoagulants is carefully discussed.

Nearly half of the monograph is devoted to case histories illustrative of spontaneous thrombosis and thrombosis secondary to tissue injury. These should be helpful not only to the clinician but also to the pathologist, because many of the histories are supported by excellent gross and microscopic studies of the affected extremities. The author has tried to select cases which illustrate the complications of thrombosis, the difficulties of treatment, and the pathologic correlation. As a result, the reader may receive an exaggerated impression of unfavorable outcome; but this should serve

mainly to emphasize the seriousness of thrombosis.

The monograph is well planned, and the illustrations are well chosen and of a high technical quality. It should prove useful to the surgeon as a thorough review of a difficult clinical problem.

J. A. SAXTON, JR.

MEDICAL DICTIONARY

BLAKISTON'S NEW GOULD MEDICAL DICTIONARY, The Blakiston Company, Philadelphia, 1294 pages, 252 illustrations, 129 in color; textbook edition, $8.50, thin paper edition, $10.75, deluxe edition, $13.50.

This dictionary has been compiled by a staff of more than one hundred contributors and represents a complete revision of previous encyclopedias in medicine and science and reflects well the advances of recent years in these fields. The editors of the book have made a careful and on the whole a successful selection of topics and names for inclusion in the volume and must be congratulated on the omission of many antiquated and obsolete terms.

In the reviewer's opinion it would have added to the value of the dictionary if the American usage of the plural form of Latin words had been included. Whereas some fields of medicine are treated in great detail (the dictionary for instance contains a list of more than 300 phobias), other specialties have received less attention. This seems to be true especially of medicial jurisprudence. Thus, although the dictionary on its cover page claims to contain medicolegal terms the reviewer has looked in vain for such items as "corpus delicti," "prima facie evidence," "release," and "statute of limitations." The illustrative material, although excellently reproduced, is not sufficiently complete to be of real assistance to the more advanced reader.

J. E. KIRK

BOOKS RECEIVED

Books received since February 1, 1950, are acknowledged in the following list. Insofar as space and time permit, some will be selected for review in a later issue, but it is unlikely that all will be reviewed.

Christian Religious Education of Older People, by Paul B. Maves, The Federal Council of the Churches of Christ in America, New York, 1950, 96 pages, paper bound, offset printed, $1.00 (reviewed in this issue, page 279).

Conference on Problems of Aging, Transactions of the Tenth and Eleventh Conferences, February 9-10, 1948, and April 25-26, 1949, New York, Josiah Macy, Jr. Foundation, New York, 1950, 258 pages, paper bound, $3.75.

Practical Neurological Diagnosis, 4th edition, by R. Glen Spurling, Charles C Thomas, Publisher, Springfield, Illinois, 1950, 268 pages, $5.00.

Quality of Medical Care in a National Health Program, A Statement by the Subcommittee on Medical Care, 27 page pamphlet reprinted from the American Journal of Public Health, *39:* 898-924, 1949, 10 cents each, $7.50 a hundred.

Report to the Community, Montefiore Hospital, New York, 1950, 104 pages, paper bound.

Thrombosis in Arteriosclerosis of the Lower Extremities, by Edward A. Edwards, Charles C Thomas, Publisher, Springfield, Illinois, 1950, 74 pages, $2.00 (reviewed in this issue, page 280).

INDEX TO CURRENT PERIODICAL LITERATURE

NATHAN W. SHOCK
Gerontology Section
National Heart Institute
National Institutes of Health

The subject categories are those used in *A Bibliography of Gerontology and Geriatrics* by Nathan W. Shock to be published by Stanford University Press, Stanford, California. Only major headings will be used and the Roman numerals correspond to those given in the bibliography. In so far as possible, references are classified according to organ systems. Thus most of the material on Geriatrics will be found under the organ system involved in the disease. Cross references are indicated by number at the end of each section. When available abstract references are given (*B.A.* indicates *Biological Abstracts; P.A.* indicates *Psychological Abstracts*). Abbreviations for journals are those used in *A World List of Scientific Periodicals Published in the years 1900-1933*, 2nd Edition. For journals not listed, abbreviations were devised according to the general rules used in the above source. It is impossible to cover all journals and list all papers concerned with aging and the aged. Authors and publishers are requested to call attention to publications or to send reprints.

GERONTOLOGY

401. Benjamin, H.: Outline of a method to estimate the biological age with special reference to the role of the sexual functions. *Int. J. Sex., Bombay, 3:* 34-37, Aug. 1949.
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403. Ginzberg, R.: Geriatrics and gerontology in everyday practice. *Individ. psychol. Bull., 7:* 21-29, 1949. Abstr: *P. A., 23:* No. 3144, 1949.

BIOLOGY OF AGING

I. CELLULAR BIOLOGY AND PHYSIOLOGY (includes plants)

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406. Winokur, M.: Aging effects in Chlorella cultures. *Amer. J. Bot., 36:* 287-291, 1949.

See also Nos. 463, 510, 665.

IV. LONGEVITY

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411. Iljin, N. A.: Können wir länger leben? Das Problem des Alterns und der Lebensverlängerung. *Universum, 2:* 112-113, 1947-1948. Abstr: *B. A., 23:* No. 14497, 1949.
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415. Seeman, I.: Why vital statistics are vital. *Hygeia, Chicago, 27:* 94-95; 124-126, 1949.
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and to length of life. *Proc. nat. Acad. Sci., Wash., 35:* 90-92, 1949. Abstr: *P. A., 24:* No. 1767, 1950.

IV-C. LONGEVITY: *Comparative Physiology*

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420. Needham, A. E.: Growth and regeneration in *Asellus aquaticus* (L) in relation to age, sex, and season. *J. exp. Zool., 112:* 49-78, Oct. 1949.
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IV-H. LONGEVITY: *Mortality Rates*

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See also No. 409.

V. METABOLISM

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See also Nos. 508, 536, 646, 655, 660.

VI. NUTRITION

434. De, H. N., and C. H. Chakravorty: Ascorbic acid requirement of Indian adults. *Indian J. med. Res., 36:* 249-252, 1948. Abstr: *B. A., 23:* No. 20724, 1949.
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See also Nos. 416, 442, 503.

ORGAN SYSTEMS

I. BLOOD

(chemistry, coagulation, and morphology)

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III. Cardiovascular System

(heart, blood vessels, blood pressure, blood volume, arteriosclerosis)

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V. Endocrine System
(includes sex glands and climacteric)

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